

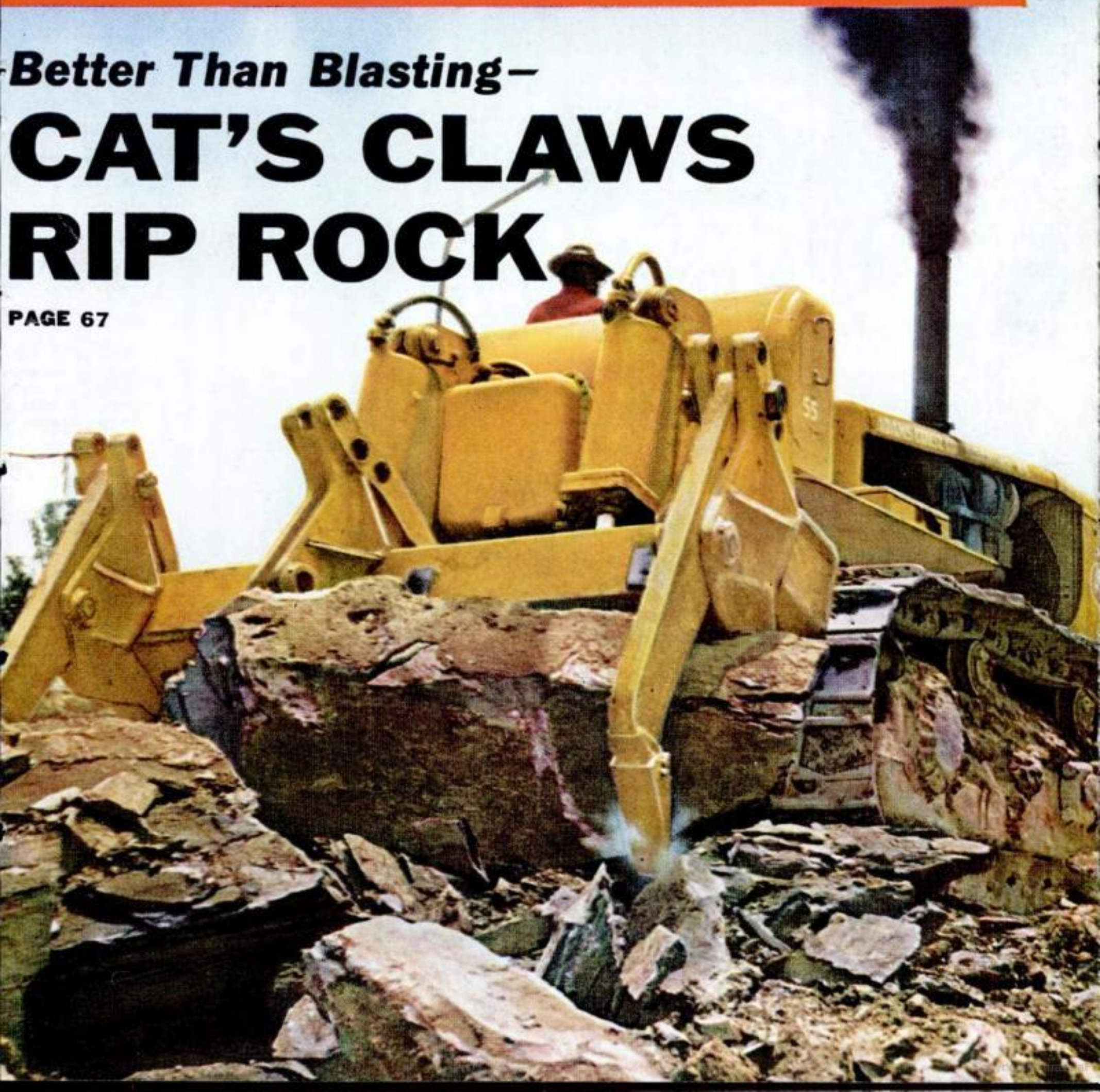
Comparing Chevy, Ford Sports Wagons

POPULAR SCIENCE

NOVEMBER • 35c *Monthly*

**Better Than Blasting—
CAT'S CLAWS
RIP ROCK**

PAGE 67



Personal Accident Insurance Direct at Cost

For Men Now 18 to 60
**GUARANTEED
CONTINUABLE**

for accidental loss of life,
sight or limbs

\$15,000

for total loss of time
(about \$325 per month)

\$75 WEEKLY

for partial disability

\$37⁵⁰ WEEKLY

Even if you have some employees' group or community medical plan, you need this vital protection as foundation for your personal security program. With Accident Insurance, the insured doesn't have to be hospitalized or suffer loss of income to be entitled to compensation for time lost by disability. And he usually does need EXTRA income when laid up, especially if he has to go to a hospital and the expenses exceed the limits of his hospital-medical plan.

For business, professional and technical men, students and all similar "Preferred" risks and for "Standard" risks including most other skilled workers such as assemblers, carpenters, electricians, foremen, inspectors, mechanics and repairmen.

Serving its carefully selected members *direct* and solely for their mutual benefit, this strong old non-profit association literally gives you *protection at cost*. Members' charges are based solely on the full cost of insurance protection, necessary reserves and operating expenses. This is world-wide coverage. We are licensed both in New York and Canada. There is no age limit for continuing accident insurance, but you must be at least 18 and under age 60 to join.

Benefits and costs are shown here:

Benefits Pay from the First Day for each accident for as many as 104 weeks of total or total and partial disability combined, whether or not your income is interrupted.

Only You Can Cancel the coverage, and the prevailing low cost can be changed only if there is a *general* adjustment in your classification, up or down.

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Also available to men...Sickness Insurance *guaranteed continuable* without modification of benefits through age 64, and *Surgical* and optional *Hospital Room* benefits *guaranteed continuable for life*.

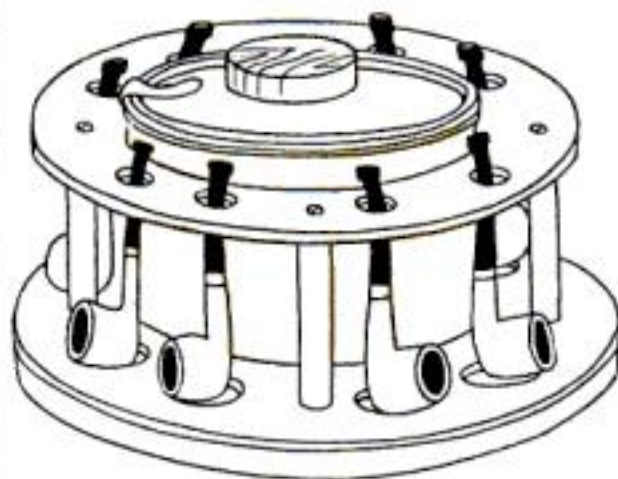
For Employed WOMEN, there's cancellable Accident, Sickness and Hospital & Surgical Insurance, and for **HOUSEWIVES** and other preferred-risk women not necessarily employed there is an excellent Accident Expense policy that is *guaranteed continuable for life*.

Choice of Amounts

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Partial disability, weekly, up to 26 weeks	37.50	25.00	12.50
Loss of life, to age 70	15,000	10,000	5,000
Loss of life, after age 70	3,000	2,000	1,000
Loss of both hands or feet, or one hand and one foot, or sight of both eyes, payable in addition to weekly indemnity	15,000	10,000	5,000
CURRENT QUARTERLY COST Preferred Risks	\$10.50	\$ 7.00	\$ 3.50
Standard Risks	14.70	9.80	4.90

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3 Second Prizes 7 gallons STA-DRI ACRYLICOTE paint—for inside or outside use.

6 Third Prizes \$24.95 Rotary Blade NORELCO SPEEDSHAVERS.

100 Fourth Prizes Large can OLD BRIAR and a fine imported briar pipe.



Old Briar mixture—rare flavor and aroma of Latakia, burleys and domestic favorites.

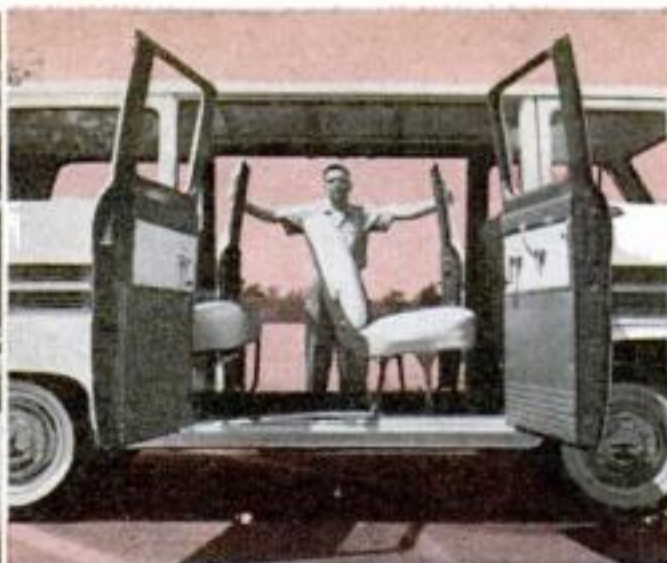
EASY TO WIN! Build a combination humidor pipe rack with a pipe tobacco can as shown above. Be original—the example above is just *one* way of building it using a tobacco can. Photograph your pipe rack, mail photo and a statement of 25 words or less on why you like Old Briar, the friendly pipe tobacco to: **OLD BRIAR CONTEST**, Box 3226, New York 17, N. Y. Your entry must be postmarked November 30 or sooner! Contest to be judged by Popular Science.

(Contest subject to all Federal, State and local regulations. Employees, and immediate families of advertiser, their agency or Popular Science staff are not eligible to enter. All entries become property of U. S. Tobacco Co. for any and all purposes and cannot be returned. Winners will be notified by mail by January 31, 1961.)

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Sky post: High up, they wait for Armageddon. P. 94



Minibus: Mammoths grow from little compacts. P. 82



Dot: An auto smaller than that dot? Here's how. P. 114

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Mechanics and Handicraft REG. U. S. PAT. OFF.

Popular Science

November, 1960

Cover photo by Robert D. Borst

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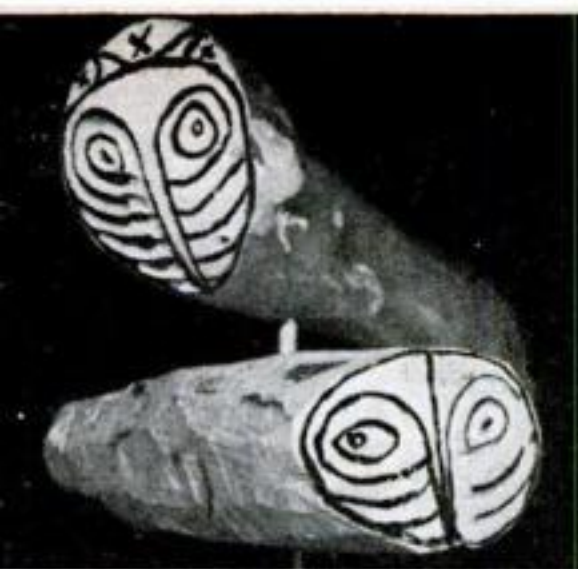
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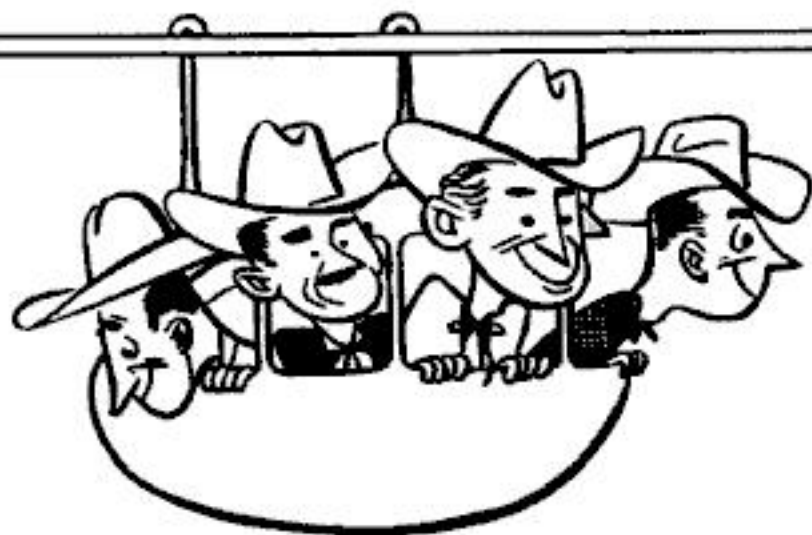
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PS Readers

TALK BACK



Texas Even Has Monorails

YOUR article "Do Monorail Trains Make Sense?" [Aug.] made no mention of the two lines in Texas: one in Houston, the other in Dallas. The Dallas line, which is 1,400 feet long with a station at each end, is now four years old. The Houston line was built a year later. The design of the proposed Japanese system is very like the one in Dallas.

Among the faults of monorails, you mention sway. As chief mechanic in charge of experimental work for five years, I'd say this is no great problem. With the shock system we use, there is no noticeable sway.

A. G. Cox, Houston.

Need a Fifth Wheel?

AFTER enjoying "The World's First Sports Car" [June], I nearly flipped when I found a Smith motor wheel complete, plus some extra parts. I lack the means to restore it, so I'd be happy to hear from some reader who is in the market for one.

JOSEPH TWORKOSKI, Macungie, Pa.

Tail-Flipping Boats

"THE Boat That Swims Like a Fish" [Aug.] reminded me of one used years ago on a lake in the backwoods of Canada. It had a fish tail—or fin—arrangement, but was foot-operated.

There was a wooden pulley on the upright stem, with a turn of small rope around it. The rope was led around two large spools on the edge of the transom, one to the right, the other to the left. Across the bottom of the boat was a board, and hinged to it with leather

hinges were two more spaced-apart boards used as foot pedals. Rope from the spools ran to the outside corner of the upper end of each pedal. This left the boatman with both hands free and it was not necessary for him to sit in the awkward position shown in your photo. The fin was pivoted a little back of center, making for a quick changeover on the return stroke.

W. A. LEA, Hollywood, Calif.

Tune-Ups, Anyone?

I READ your magazine avidly—and believe me, it's a race to get it before my husband does. I especially enjoy the home-improvement section. We try out your ideas on our new house.

Since taking your "Tune-Up Quiz for Car Owners" [Sept.], I've decided to go into the car tune-up business. Knowing very little about what makes a car go, I



passed with 90. Pretty good for a female. Anybody got any cars to be fixed?

BARBARA KNOWLTON, Glendale, Calif.

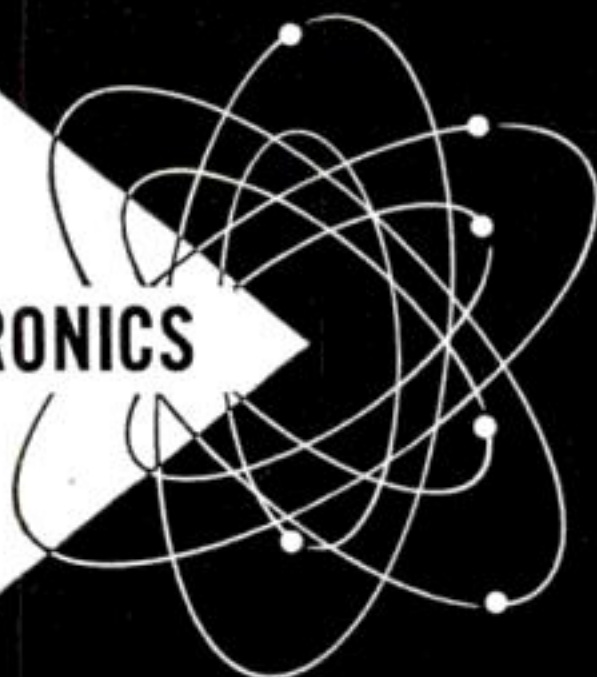
More Driving Tricks

"TRICKS for Driving Two-Lane Roads" [Aug.] reminded me of a trick I find useful. When driving at night, I watch the telephone poles above the road. Many times, light reflected off them will warn you of approaching, unseen cars hidden by turns and small hills.

ROBERT TAYLOR, Lancaster, Pa.

... I HAVE a couple of tips of my own for driving on two-lane roads in the daytime: I always turn on my headlights when the sun is behind me. This gives a driver coming toward me a chance to see

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me. I do the same just before passing. It's amazing how many drivers will notice you—proving it by flicking their own lights to warn you that yours are on.

T/SGT. H. W. RICHARDSON,
Stead AFB, Nev.

An Ounce of Lubrication

HERE'S a suggestion for power-tool owners: Many such tools show amount of lubrication needed in ounces. This can be determined easily by remembering that two tablespoons equal about an ounce of lubricant. The measuring divisions often shown on a quarter-pound stick of butter are also handy when measuring cup grease.

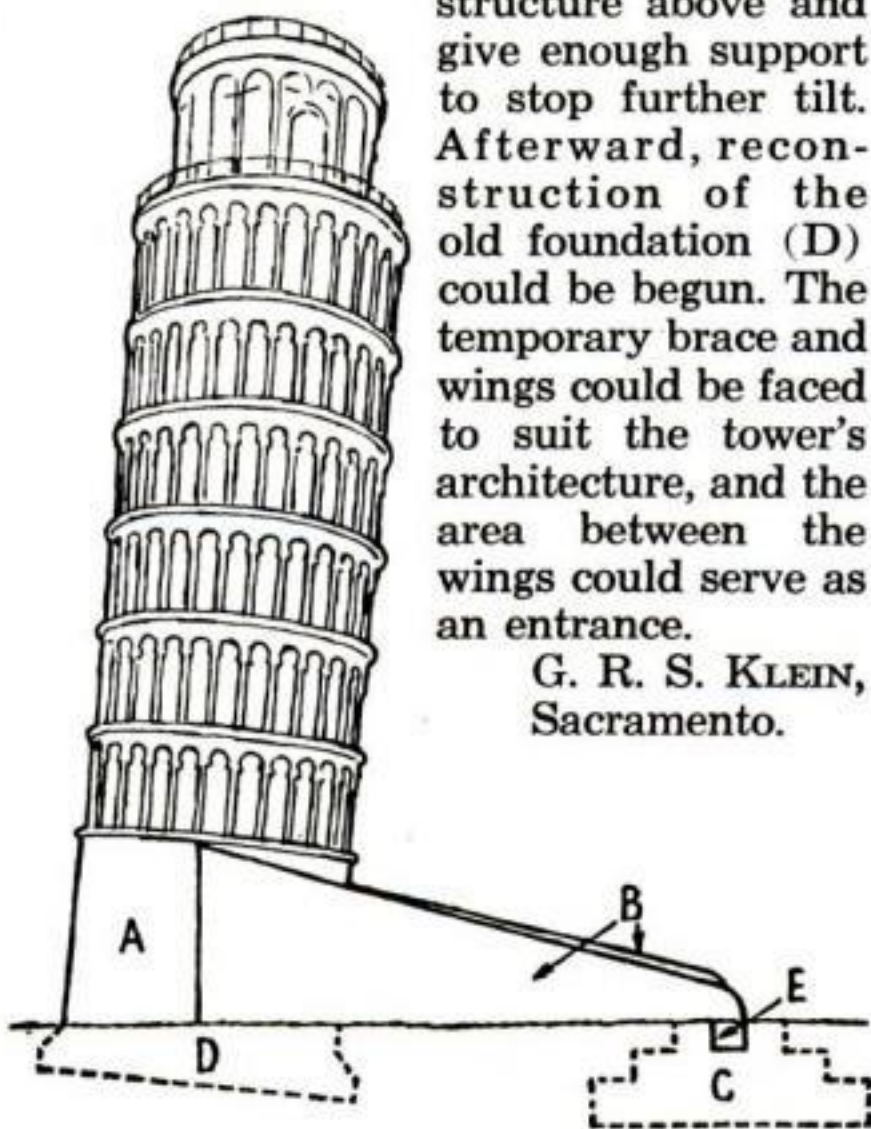
E. R. ACE, Rockville Centre, N.Y.

Helpful Hints for Leaning Tower

HERE'S a hopeful suggestion for the Tower of Pisa ["The Leaning Tower Is Falling Down," Sept.]: Put a steel brace (A) around its lower section. Attach to this two wings (B) of steel bridge construction, leading parallel in the leaning direction to an underground anchor (C). Run a beam (E) through this and connect the ends of the wings.

This should eliminate pressure on the structure above and give enough support to stop further tilt. Afterward, reconstruction of the old foundation (D) could be begun. The temporary brace and wings could be faced to suit the tower's architecture, and the area between the wings could serve as an entrance.

G. R. S. KLEIN,
Sacramento.



... I'M NO engineer and maybe I'm way out, but why don't they concentrate on the high side, where the terra seems

CONTINUED

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There has never been anything like these "Progress Kits" available — for completeness, authority and detailed step-by-step guidance. Nothing has been left out. The expert business leaders, psychologists and educators who planned the Program have included all the know-how and *actual practice* you need. Their simplified new self-instruction method enables you to gain "practical experience" in the odd moments that now go to waste every day.

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To introduce you to this new kind of personal achievement plan, Nelson Doubleday offers you a valuable "sample kit" almost as a gift. You'll receive a remarkable 10,000 word handbook — *How To Remember Names and Faces* — that gives you the secrets of professional memory experts. In the first five pages you'll learn one easy trick that will double your memory power — *overnight*. Soon your new "automatic memory" for names, faces, facts will win new friends, gain recognition on the job.

As with each Progress Kit in the Program, a set of handy practice and application cards accompanies the memory handbook to help you "learn by doing." Slip them into the pocket holder provided — for use in your spare moments. They've been scientifically planned to add a "real life" dimension to self-instruction.

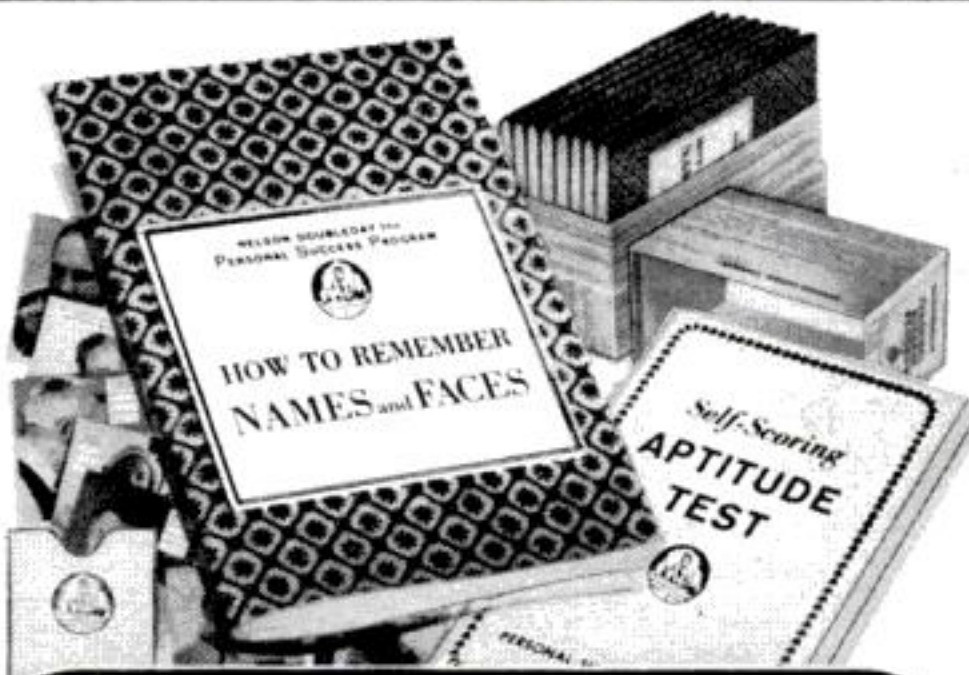
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to be firma? A counterweight properly designed and installed, maybe. Remove the extra load on the low side, and add it to the high side. If the original lean was not intentional, the ground must be more solid on the high side.

BILL MAMMANO, Glendale, Calif.

... Did anyone ever try to pump out the sand or dirt at one side until the tower is level? Or maybe dig in at an angle, deep enough to build a basement with a solid top that the tower could settle onto?

GOLDIE DILLEY, Phoenix, Ariz.

... CEMENT under high hydraulic pressure has been forced under our highways to give solid footing to old soft and broken sections. Has this been tried by the Italian Government?

R. E. SCHUMM, Kalamazoo, Mich.

... I SAY erect eight cement columns, each six feet in diameter, placed octagonally around the tower. From these, extend eight huge girders. Then lift the tower upright with a crane and fill the hole beneath with steel-reinforced cement. When the cement is dry, lower the tower and bolt it down.

GUY B. SLAGLE, Reno, Nev.

He Saved \$1.96

HERE'S a picture of my \$20 dinghy, built from your plans [July]. I altered



them slightly and added a low front seat. It took my wife and me exactly one week to finish it (we were leaving in a week for our vacation when the magazine arrived).

The wood cost us \$8.72. Oars and oarlocks, screws, nails, glue, and paint were another \$9.32. So I was still ahead of your estimate of \$20.

The kids loved the dinghy, and though

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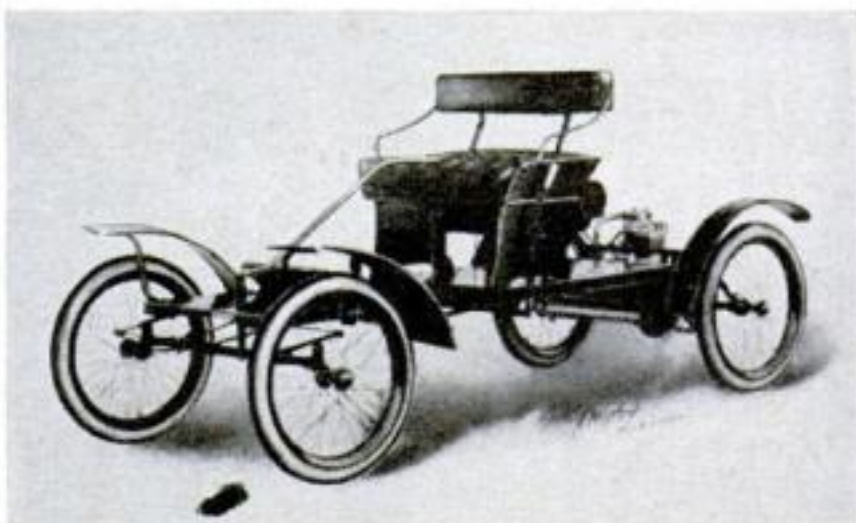
At paint and hardware stores everywhere.

the oarlock position looks awkward it handles very well. While we were putting it together, my wife said, "You know, this building something really is fun, isn't it?" I couldn't agree more.

A. L. IVEY JR., Richmond, Va.

FIRST First Sports Car

THE frisky little car Mr. Fry asks about in your September letters column was built by the Waltham Mfg. Co. (no connection with the watch company), and called the Orient Buckboard.



In 1904, I undertook to drive a Buckboard from Boston to Chicago as a publicity stunt for the maker, but didn't get across the state by the time my vacation was up. It was a good little machine, but I was a very poor mechanic.

HI SIBLEY, Nuevo, Calif.

... THE Orient Buckboard is the car Mr. Fry remembers. It was made by the same people who made the Orient bicycles. Later the company was taken over by Charles Metz, maker of the Metz car.

H. F. WHITNEY, Southbridge, Mass.

... THIS car was made by the Orient Bicycle Works in Waltham, Mass. It dates earlier than 1905, more like 1898 if recollection of my mother's tales serves me. She told of riding on the Buckboard when she was a little girl.

FRANK DALEY, Fenton, Mich.

... BUILT by the Orient Cycle Co., the Buckboard was popular during 1905-1910. Some had DiDion motors.

I owned an Orient motorcycle built for motor pace races. It had an Aster motor built in France. A friend had a five-place bicycle made by Orient. This was used for pacing solo riders.

During 1911-1916, Orient's Metz came out. This job had a friction transmission with chain drive to each rear wheel, and

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"I had a successful Radio repair shop. Now I'm Engineer for WHPE." **V.W. WORKMAN**, High Point, N.C.



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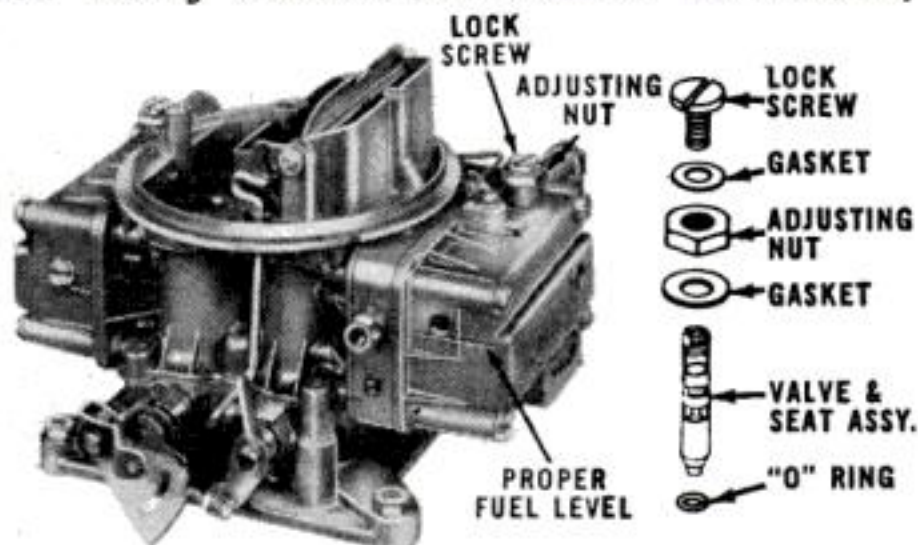
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ONE SIMPLE ADJUSTMENT TO YOUR HOLLEY CARBURETOR

If you are getting poor idle or unsatisfactory fuel economy, one cause may be improper fuel level in the bowl. Because of the accessibility of the adjustable needle and seat arrangement on Holley 2-barrel and 4-barrel carburetors,



it's a simple matter to check the fuel level. Here are the easy steps: (1) Make sure the car is on level ground, then start the engine. (2) Remove the sight plug to check the fuel level in the bowl. (It should just reach the lower lip of the sight plug.) (3) If the level is too high or too low, loosen the lock screw with a screwdriver. Turn the adjustment nut clockwise to lower the fuel level—counter-clockwise to raise it. A $1/6$ turn is the equivalent of $1/16$ -inch wet fuel level in the bowl. (4) Operate the engine until the fuel level is stabilized, then recheck level at the sight plug. Be sure to replace the sight plug. This adjustable needle and seat arrangement is one of many important developments of Holley's continuous research and engineering. There are, of course, other causes of unsatisfactory idle and economy. If this simple adjustment does not correct the trouble, your Holley dealer will be glad to make a thorough check of the carburetor.

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14 POPULAR SCIENCE NOVEMBER 1960

an engine similar to the Model T Ford's. A Metz Sporter, on the order of a Mercer, had wire wheels and could do up to 50 m.p.h. on the level.

H. R. HOLBROOK, Portsmouth, N. H.

... THE Orient Buckboard had no fifth wheel. It carried its engine behind the bucket seats.

In 1900 I had a small part in the first international automobile road race—Paris to Berlin. I've been connected with the automobile industry ever since.

JOSEPH SCHAEFFERS, New Bern, N. C.

Forerunner of the Falcon

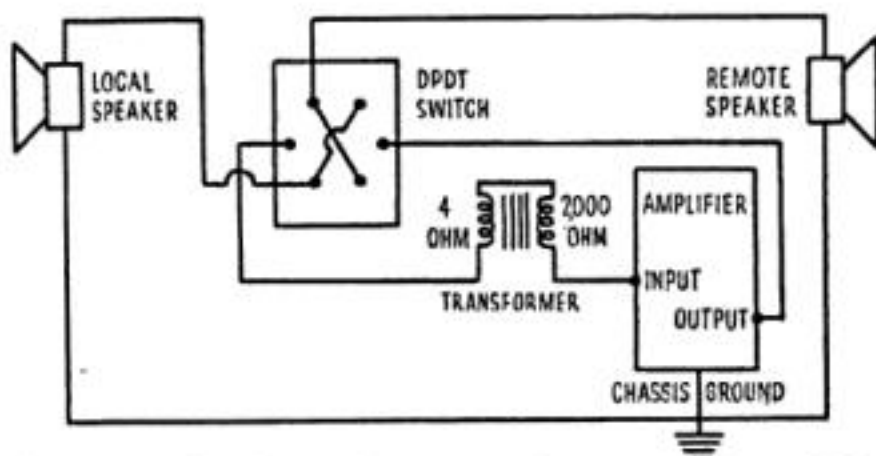
THE car you call Falcon's forerunner, and which you claim was never produced ["Henry Ford's Weird Old Engines," Aug.] is a Vedette. This car was produced by "Ford of France," 1949-1954, with slight grille changes. It was dropped when Simca bought out the company. In '55, Simca produced the Simca Vedette, a car similar to the English Consul—but the real Vedette had died.

PATRICK MANDEFIELD, Montreal.

Bypassing Alexander Bell

THE boys who set up an amateur telephone system ["PS Readers Talk Back," Aug.] reminded me of a similar system I constructed. I used an amplifier, only two speakers, a double-pole, double-throw switch, and an output transformer from an ordinary AM radio.

The speakers were wired, one wire to the ground of the amp, and the other wire to the DPDT switch, as shown. Then

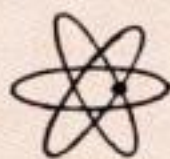


I crossed the wires to the opposite side of the switch. One of the center terminals of the DPDT switch was connected to the ungrounded terminal of the output of the amp. The other center terminal was connected to the four-ohm side of the output transformer (either wire). One of the wires on the 2,000-ohm side of the transformer is connected to the ungrounded

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side of the input of the amplifier. The remaining two transformer wires are connected together. The switch reverses the speaker connection to the amplifier so that one is input, one output, and vice versa. Only two wires are needed between the master and the remote. I used a 12-watt amplifier for the power.

I mounted the master (speaker, switch, transformer) in a cigar box and ran two wires to the remote, a short shielded cable to the input of the amplifier, and one wire to the ungrounded side of the output terminals. These five wires all came from the box.

FRED GARDNER, Marinette, Wis.

Later Than She Thought

THE lady who wants a bottle opener built into her refrigerator ["I'd Like to See Them Make," Aug.] is not the first to think of this one. Norge has put an opener on at least one model.

GARY GOSSINGER, Detroit.

... LET me quote from the manual that came with our refrigerator: "All International Harvester refrigerators are equipped with a built-in bottle opener on the door strike." Ours also has a magnet that keeps the caps from falling to the floor.

G. W. G. RODIER, Springfield, Mo.

Unmarked Cop

I was tagged by a cop in an unmarked car while driving through Pennsylvania. This was a real ringer—the car was his own, and so was his uniform. He was wear-



ing an old winter hat and a raincoat, and needed a shave. It was impossible to tell he was a police officer. But I paid.

WILLIAM GILDONE, Conneaut, Ohio.

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of the unbound issues were lost and we found that some folks didn't take care of them very well. As you can see, I have



made two nice books of the issues for 1957.

The camp lies on the Agusan River. Rafted logs are towed by launch downstream to our mill. We'd be happy to have readers send us books and magazines for our library.

FELIPE T. JIMIERA
Tungao Logging Camp
Butuan City, Mind., P. I.

Another Vacuum-Engine Buff

YOUR pictures of the rotor ["Adventures with an Old-Time Engine," Aug.] stopped me cold. It was like looking at an old friend. I was given a vacuum rotor for my birthday 42 years ago, and had it up to about a year ago. I finally broke down and gave it to a young friend. The motor still runs and looks like new.

I know how Harry Walton felt when part of the lettering on the nameplate came off—the same thing happened to me. Tell him that his assumption that the whistle had a lock nut on it originally may be wrong. Mine never did. The water jacket between the oil part and the whistle should be full of water. It gets hot and steams and makes it more fun to run the motor. It also saves the cylinder.

L. D. CHAPMAN, St. Louis, Mo.

Watch Those Turn Signals

I WONDER how many other drivers have noticed the appalling increase in the number of auto turn indicators that fail to cancel? There was a time when the indecisive hand signaling of females inspired a raft of jokes and irritated mutters of "she's going to do something; go

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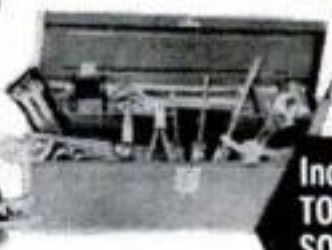
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right, go left, or maybe up or down." Today, with the mechanical signals giving false information, the joker ahead of you blinking for miles may well be male.

Since we can't depend on drivers to replace or repair faulty indicators, or—heaven forbid—expect them to return the lever by hand, can't somebody turn out a more dependable gadget?

M. E. COOPER, Chicago.

Short Cut Too Short

YOUR Short Cut on "How to Make a Scaffold Anchor" [Aug.] is a good idea but omits two safety rules: Never rest a scaffold on top of ladders but insert it between steps so you can't step off an end. Clamp or otherwise fasten the scaffold to the ladders so it can't be readily shifted out of place as you work.

F. A. COLBURN,
Dracut, Mass.



Coffee Brewer Brews Up a Storm

THE automatic coffee machine you call a "German invention for restaurants" [Aug., p. 75], actually is an American invention. It brews a cup of coffee from fresh grounds and serves it within 10 seconds after a coin is inserted.

We sent one of our portable machines to the International Restaurant Show in Hamburg, Germany, where the photograph you showed was taken. Apparently it was incorrectly captioned there.

K. C. MELIKIAN

Rudd-Melikian, Inc., Hatboro, Pa.

Gus Didn't Paint the Picture

IN "Gus Tangles with Lightning" [Aug.], your picture shows the rear end of a '57 Ford (Fairlane emblem, rear fins, round tail lights, cutaway bumper). Then you say that Gus tapped the terminal clamps down on a six-volt battery. Every '57 Ford that I've seen has a 12-volt system.

J. J. HALL, St. Louis, Mo.

... ONE point eludes me: How could a "hot wire," falling on a car not ground-

CONTINUED

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prongs of V; (2) loose end of chain with fastener-plate is pulled around tire, and (3) prong on outside chain is inserted in opening on fastener-plate and presto! chains are locked in place. No need to jack up wheels even when rim-deep in mud or snow. Available in sizes to fit all cars and

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What's so special about the Buick Special?

The answer? Everything! Smaller than big, yet bigger than small, this all-new Buick Special gives you the room, ride, go and pride of the costliest cars with the savings and ease of the small. Here's how Buick achieved this engineering miracle:

ENGINE: Revolutionary. The Fireball Aluminum V-8 is a water-cooled engine made almost entirely of aluminum. Its .487 horsepower per pound gives you the industry's highest horsepower to weight ratio. Performance? You can go from a standstill to expressway speed as safe and sprightly as in many a full-size car. Economy? With all its go, the Special is right up there with the compacts for gas savings.

TRANSMISSION: Exceptionally lightweight, automatic transmission* with aluminum housing and many aluminum parts. It works on a "dual path" principle. When cruising, about 70 per cent of the driving forces go through a turbine torque converter and 30 per cent through a planetary gear set. This way you get the go and gas savings of geared transmission with the smoothness of turbine drive. And for stick-shift levers there's an action-packed Synchronesh transmission that's as delightful for gas savings as it is for git.

PROPELLER SHAFT: The Special's new Hide-Away drive shaft lowers the hump, gives more flat floor space, greater foot room and softer seating for the "man in the middle." A special "constant velocity" universal joint keeps driving power flowing to the differential with perfect smoothness.

SUSPENSION: Here's a real luxury feature in new-size cars — full-coil suspension — the same type used on the full-size '61 Buicks. Front stabilizer bar and a new link-type rear mounting stabilize the ride perfectly, giving flatter cornering and a smooth "all-day" ride. The Special also uses the same hydraulic shock absorbers, front and rear, as the larger Buicks.

BODY: Full, unitized construction. It's tight and snug. Absence of heavy frame cuts dead weight for extra gas savings.

MODELS: A handsome four-door sedan and an amazingly roomy four-door station wagon with convenient full-height liftgate.

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ed, "glare fiercely, then subside, arc-welded in place"?

P. M. KAHRS, Colorado Springs.

... IF THE couple in the car were safe because of the tires, then the car did not have a ground; hence it wouldn't seem possible for a live wire to arc enough to weld to the bumper.

T. F. Watts, Charlotte, N. C.

At the time of the wire's initial contact, tires and pavement were dry. When it rained, tires and pavement were wet with mineral-rich drippings from the dirty car, providing an electrical path to ground.

Oil for Electric Clocks

THERE'S an easier way to restore the sealed-rotor motors ["How to Fix Electric Clocks," Sept.] than by squirting oil through a hole in the side. Put the motor in a steel cup containing just enough light oil to cover it. Heat the oil until you see bubbles coming out around the pinion. Now turn off the heat and let the oil be drawn back into the housing to fill the space left by the expanding air.

This treatment has put my kitchen

clock back on its feet for an additional six months' service each of the three times I have used it.

MOSE MALLETT, Chattanooga, Tenn.

Full Circle

BACK in 1914, I worked on a walking dredge similar to the one you pictured ["Tanks That Walk and Jump," July].



This machine had egg-shaped gears that drove the crank connected to a leg and

[\[Continued on page 64\]](#)



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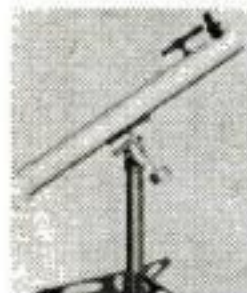
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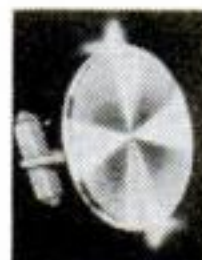


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The month in science

Making the bombs safe. Last summer an A-bomb-loaded Bomarc missile burned up on the ground at McGuire Air Force Base, N. J., alarming citizens all around. Suburbanites 100 miles away were saying, "An A-bomb exploded down at McGuire."

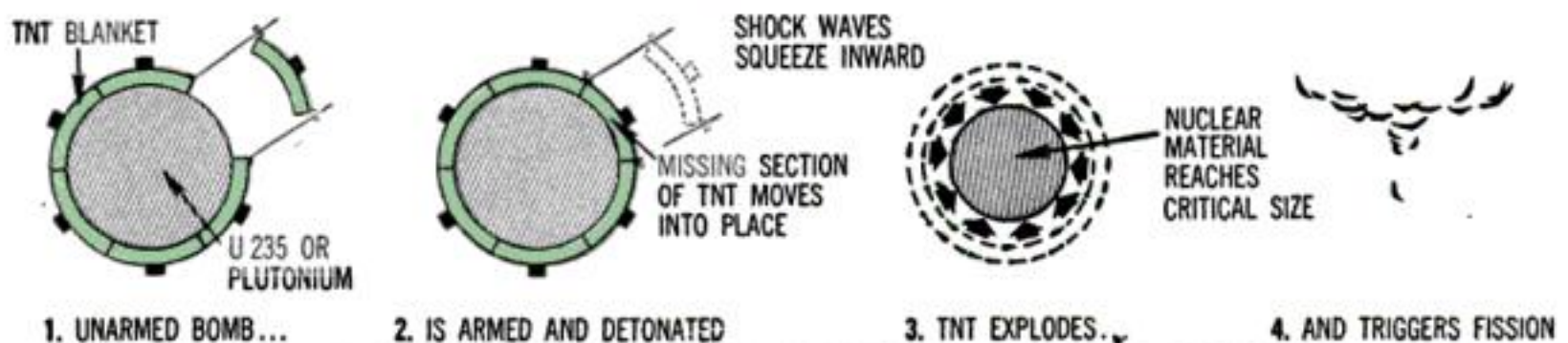
It didn't explode. And it couldn't explode. That's the reassurance from the Army-Navy-Air Force-AEC people who worry about such things. The worry is real: Bombs are now in the air and on the ground the country over (for the latest defense plan, see p. 94).

The experts say there's less than one chance in a billion that any American nuclear weapon will go off unless the President of the United States orders it to. They have now revealed some of the elaborate precautions, which allow for three main possibilities:

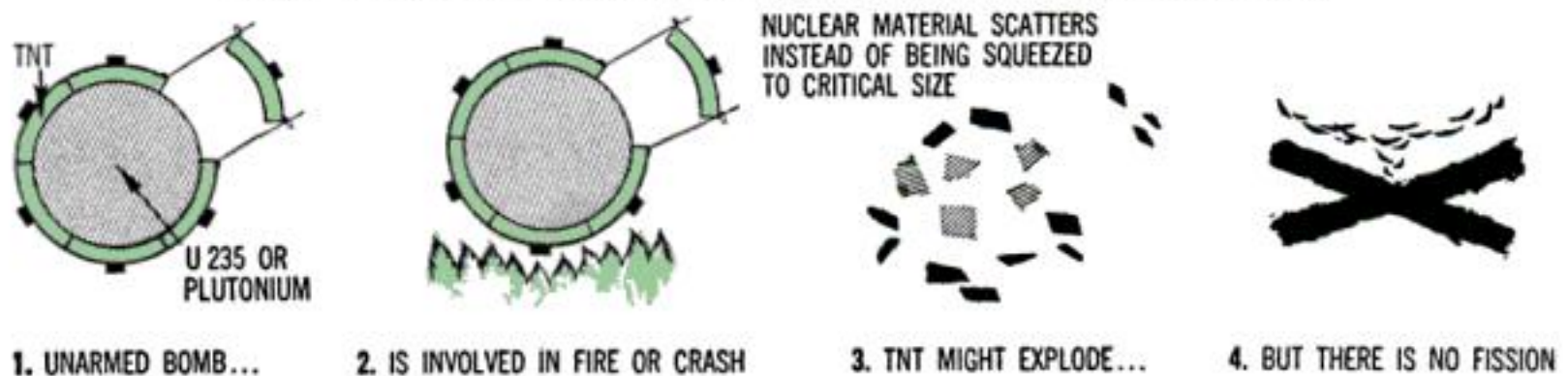
1. A bomb falls on friendly territory by mistake—a plane crashes (that's happened), a bomb drops loose (that's happened), fire or non-nuclear explosion reaches a bomb (that's happened), or an ICBM goes astray (not yet, but possible).
2. Somebody accidentally pushes the wrong button.
3. Somebody's trigger finger gets itchy and he *intentionally* pushes the buttons when he is not supposed to.

The mechanical precautions, surprisingly, are the simplest and surest. A nuclear weapon can be burned, blasted, or smashed without going off. There may be an explosion, but it would be an ordinary chemical explosion—dangerous, yet hardly in the same league with a nuclear explosion. This protection comes

WHY AN A-BOMB GOES OFF WHEN IT IS MEANT TO—



BUT CAN'T GO OFF WHEN IT IS NOT MEANT TO



from the very nature of the atomic bomb (which is also the trigger for the hydrogen bomb).

To make U 235 or plutonium atoms split, you have to pack enough of them close enough together (the "critical mass"). The bomb does this by encasing a fistful of these atoms in TNT. When the TNT blows, shock waves squeezing in concentrically compress the fistful to critical size—*whammo!* If you remove a

The month in science continued

section of the TNT casing, explosion of the remaining TNT just scatters the nuclear material—without fission.

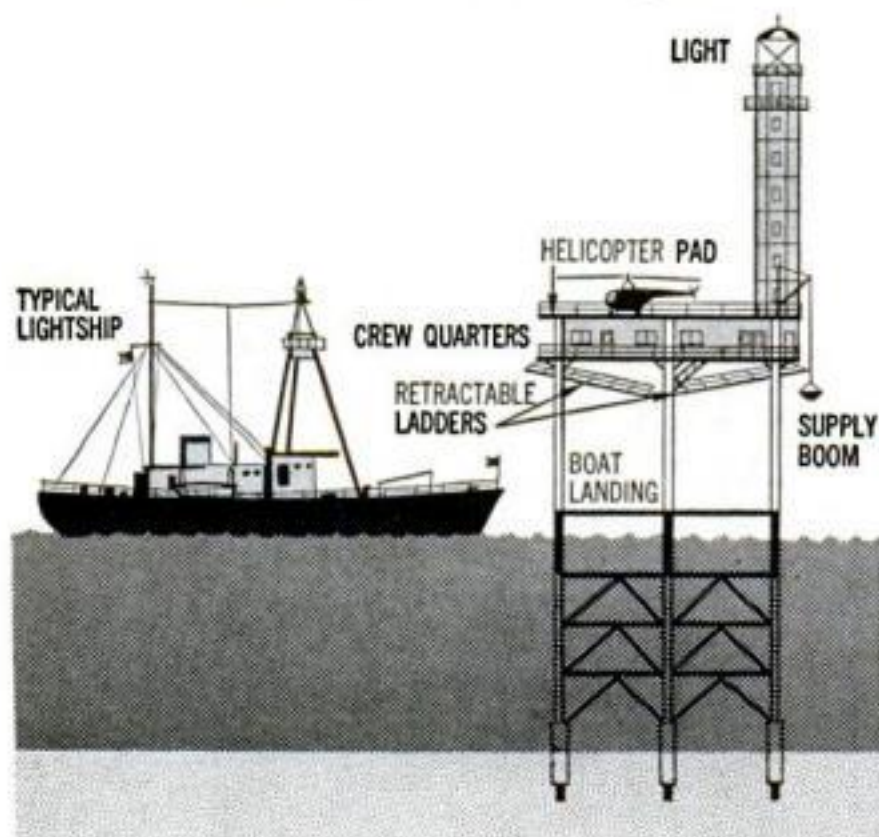
This fact is used to prevent premature blasts. For example, one section of TNT casing may be mounted separately, away from the nuclear material. It moves into detonating position at the latest possible moment.

The detonation system is electrical, and the batteries are not even kept in the bomb ordinarily. There are a whole slew of buttons to press, in sequence. Many of them have to be unlocked—pins removed, seals broken, padlocks opened. Some switches are way down inside the works—the bomb has to be partly disassembled to set them, then reassembled. The final switch won't close until the bomb is falling on its target.

None of these schemes would protect against a zealot. So crews are carefully selected—steady, intelligent men who can carry out orders precisely under pressure, but no geniuses who are convinced they can do things better than the way it says in the book.

The crews are watched—anyone who gets into woman-trouble or money-trouble (which might cloud judgment) quickly finds himself on a new assignment. And finally, nobody ever approaches a nuclear weapon alone. Even if he did, he couldn't fire it alone—it takes at least two men (usually more).

Lightships out. The old red-hulled lightships that guide mariners along coastal approaches are on their way to the scrap yard. In their places will rise Texas Towers, the man-made islands originally developed for oil prospecting in the Gulf of Mexico. The Towers are better and cheaper:



- ▶ The lights will be higher (so they can be seen farther off), and they won't bob. Fog signals can be aimed for better effect.
- ▶ Towers can be accurately positioned—and won't drift.
- ▶ They hold more electronic gear.
- ▶ They can be manned by a smaller crew (five men).
- ▶ They should last half again as long as ships.

The towers are steel platforms with legs set into the ocean bed. Men and machines are

housed in a deck about 60 feet above sea level. There's a helicopter landing pad on the roof. The light sticks up 75 feet higher from a tower on the tower.

First of the light towers will rise in Buzzards Bay, at the southern approach to New England's Cape Cod Canal, early next year. The framework will be assembled on shore, towed on its side to the site, then tipped upright by a derrick barge.

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As an electrical trouble shooter the Model 70:

- Will test Toasters, Irons, Broilers, Heating Pads, Clocks, Fans, Vacuum Cleaners, Refrigerators, Lamps, Fluorescents, Switches, Thermostats, etc.
- Will test all TV tubes for open filaments, inter-element shorts, burned out tubes, etc.
- Measures A.C. and D.C. Voltages, A.C. and D.C. Current, Resistances, Leakage, etc.
- Will measure current consumption while the appliance under test is in operation.
- Incorporates a sensitive direct-reading resistance range which will measure all resistances commonly used in electrical appliances, motors, etc.
- Leakage detecting circuit will indicate continuity from zero ohms to 5 megohms (5,000,000 ohms).

As an Automotive Tester the Model 70 will test:

- Both 6 Volt and 12 Volt Storage Batteries • Generators • Starters • Distributors • Ignition Coils • Regulators • Relays • Circuit Breakers • Cigarette Lighters • Stop Lights • Condensers • Directional Signal Systems • All Lamps and Bulbs • Fuses • Heating Systems • Horns • Also will locate poor grounds, breaks in wiring, poor connections, etc.

IT'S SO EASY!!



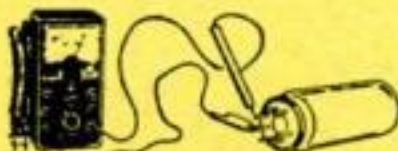
With tester's cord in outlet, current consumption of appliance is read direct on meter when line cord is connected to receptacle on panel. This typical iron takes 7 amperes (Good).



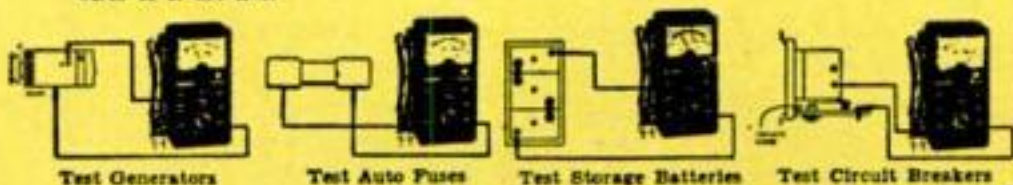
Small electric fan motor indicates 50 ohms (normal resistance).



Control circuits of most furnaces use 24 volts obtained from step-down transformer. Here's how to check room thermostat to see if wires to it are live.



Manual supplied with Model 70 shows meter needle moves to right when test leads are connected to pins 3 and 4 of this 6AU6 tube. Procedure for testing all tubes used in TV are detailed in manual.



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- How to test all TV tubes; also simple procedure for determining which specific tube (or tubes) is causing the trouble.
- How to trace trouble in the electrical circuits and parts in automobiles and trucks.

Model 70 comes complete with above \$15⁸⁵ book and test leads. Only ...

PS Puzzlers By Joan Steen

Some bafflers to bait bright minds . . . Answers on page 240



But Which Man Voted for Jones?

WITH the election, we thought you'd like to tackle a little voting problem:

The Board of Elections in a small town consists of five men: Smith, Jones, Brown, Peters, and Thompson. At their first meeting this fall they were sitting at a round table in the above order and decided to elect a new chairman. The

first ballot was a stand-off. Each man got a single vote. No one voted for either of his neighbors, or for himself. The second time around they stuck to their original choices except for Brown, who now voted for Thompson. Thus Thompson became chairman. Now who voted for Jones on the first ballot?

.....

THREE quickies—no fair dawdling over them:

1) In a poor Asian town of 20,000, five percent are crippled and wear only one sandal, half the rest go barefooted. How many sandals are worn in all?

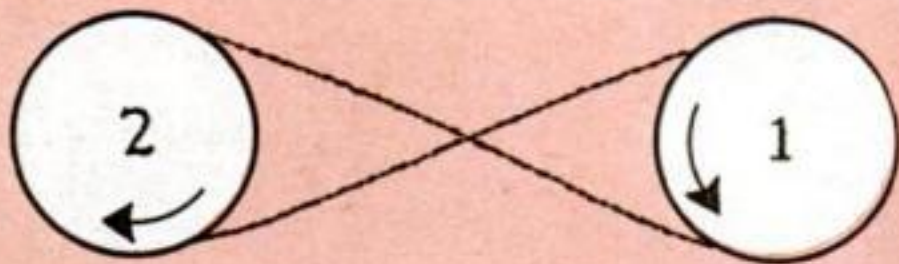
2) Is it possible for two men, wholly unrelated, to have the same sister?

3) Over the breakfast table one morning toward the end of November, Ted

White said to his wife, "Think I'll cut down on my smoking. Beginning today I'll smoke 13 cigarettes a day, but every third day I'll cut down to three. I'll see how it works—at least until the end of the month."

"Silly," his wife said, "why not make it 10 a day—it comes out the same."

She was right, of course, so what day of the month must it have been?



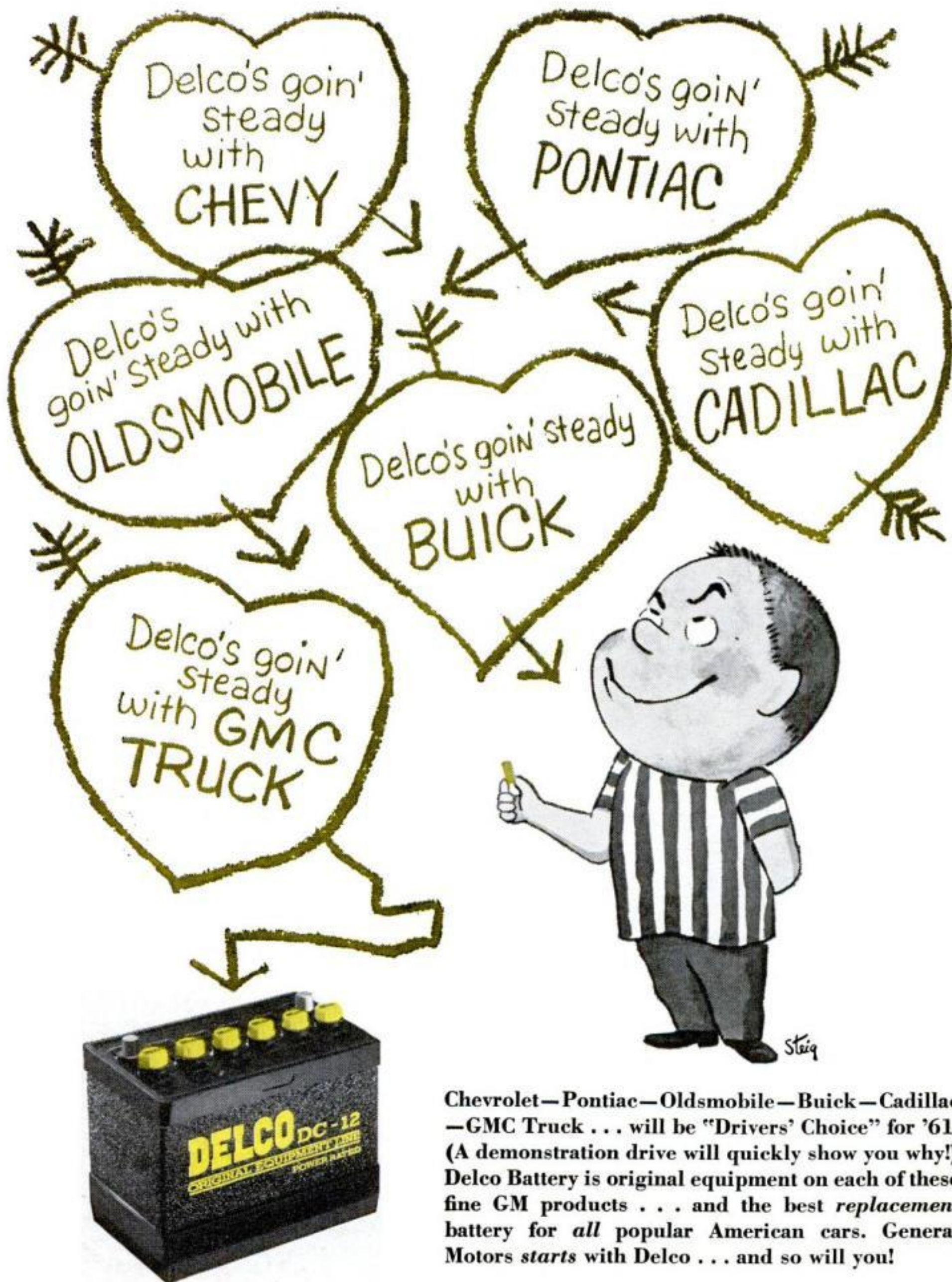
HERE'S a puzzle that will test your mechanical resourcefulness:

You have a pair of line shafts in the shop running parallel, side by side. Shaft 2 is to be driven in the opposite direction to Shaft 1 by means of a belt. You reject the usual crossed-belt arrangement (above) since it's too wearing on the belt.

What fix can you come up with if you limit yourself to a belt and pulleys only? Can you figure it out without using pencil and paper?



EVER notice that seven pennies can fit together in a perfect cluster—six outer ones just touching each other and all hud-



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PS Puzzlers
continued

dled about one in the middle? Try it.

Now suppose you have only six pennies, arranged in two rows. Can you still make a perfect ring of them without the anchor coin in the middle? (You should be able to drop a seventh penny inside so that it just touches the others.)



SMILING SAM, a used-car dealer, sold two cars for \$600 each. One was a dandy, in good condition, and he cleared a 20-percent profit on it. The other his brother-in-law had stuck him with and he took a 20-percent loss on it.

Totting up his figures, he stopped a minute. Had he lost or gained on the deal? And how much?

Puzzle of the month



HERE'S a version of Sam Loyd's "Convent Problem"—one that belongs to a class that sound impossibly paradoxical. There is a legitimate answer.

Some boys at Adams School live in a dorm that dates back to the time of the school's founding. It's a square three-story building with the boys' bedrooms on the top two floors. There are six windows on each side, eight bedrooms per floor. The top floor, however, has more beds and can accommodate twice as many boys as the second floor. The founder, an eccentric school-

master, stipulated that every room was to be occupied and that there should be twice as many occupants on the top floor as on the second. Further, there should be exactly 11 boys in the six rooms on each of the four sides of the building. The rule was still in effect.

One Saturday the boys went down to Dover Prep for the football contest of the year. They neatly trounced their rivals and whooped it up into the night. They celebrated so much, in fact, that nine of the boys missed the bus back to Adams—a serious infraction of school rules. Anxious to cover up for their friends, the rest of the boys devised a way to rearrange the sleeping plan of their dorm so that—miracle of miracles—the old rule would be unbroken and their friends would not be missed. How many boys were there in all, and how did they arrange themselves?

Answer to last month's P-O-T-M: A, B, and C had amassed points for first, second, and third places in field and track events. A got 22 points; B and C, both 9. B got first in javelin-throwing. Who placed second in the 100-yard dash?

Not so impossible, really. First add up the points. They total 40. Now A, B, and C were the only contestants, so they must have split up first, second, and third places in any event among themselves. We assume further that each event was scored the same way, with whole number values grading down from first to third place. You can then make a table of the possible combinations:

Table with 2 rows and 7 columns: Number of events, Points per event, and values 2, 4, 5, 8, 10, 20, 20, 10, 8, 5, 5, 2.

For each combination you can assign points for each place. (If the points per event are 10, you could try 5 for first place, 3 for second, 2 for third.) Soon you can eliminate every possibility but one: Five events with 8 points each, assigned 5 for first place, 2 for second, 1 for third. A took four first places and one second (Total = 22). B took one first place (the javelin-throw) and four third places (Total = 9). C took four second places and one third place (Total = 9).

Now both A and C took second places. How can you determine which took second in the 100-yard dash? Again by logic. Since A won four out of five contests he could only have taken second in the javelin-throw, right? So C placed second in the 100-yard dash.

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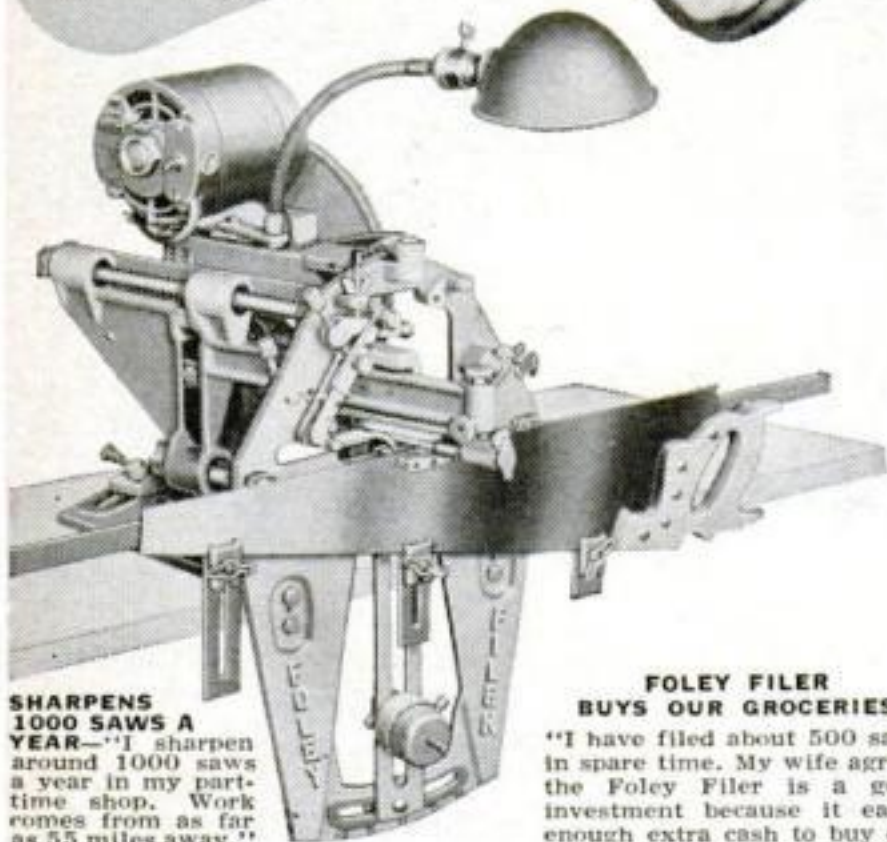
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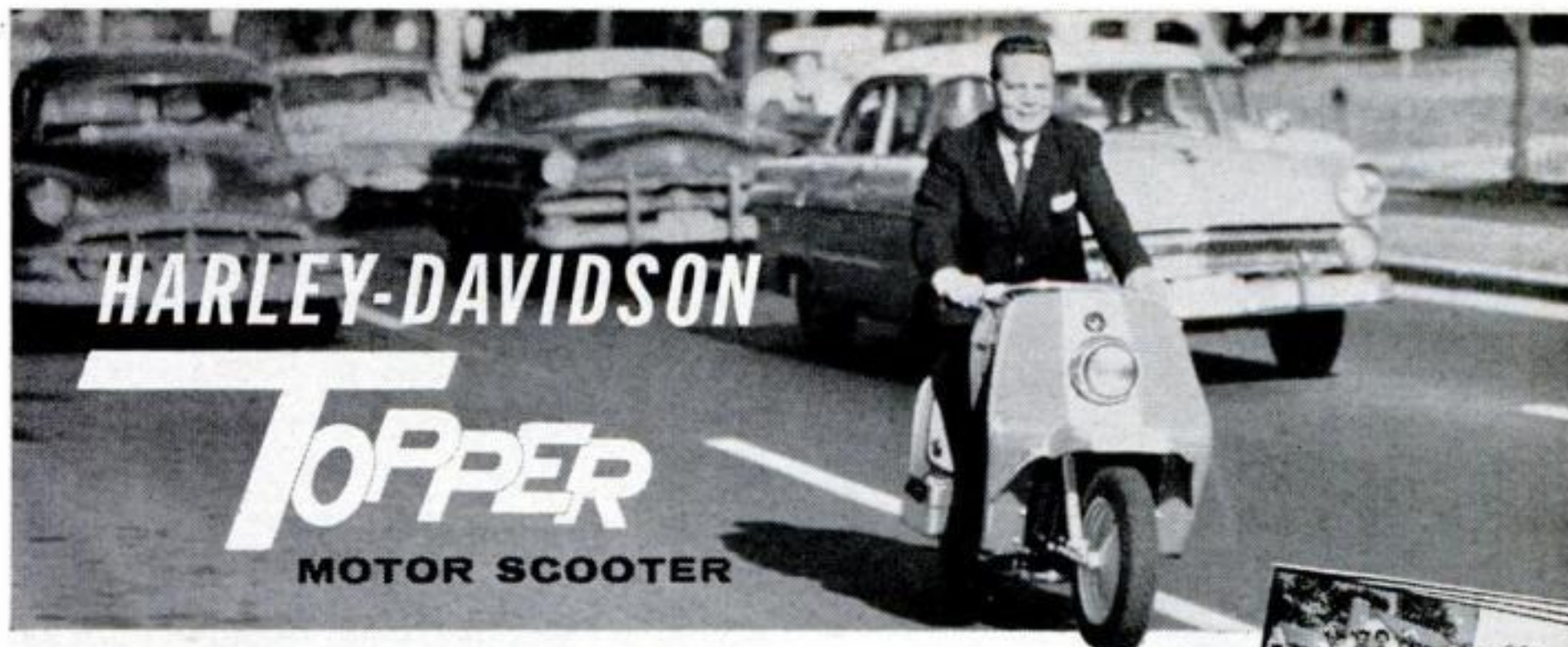


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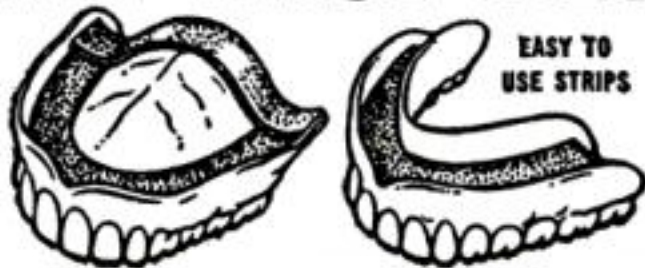
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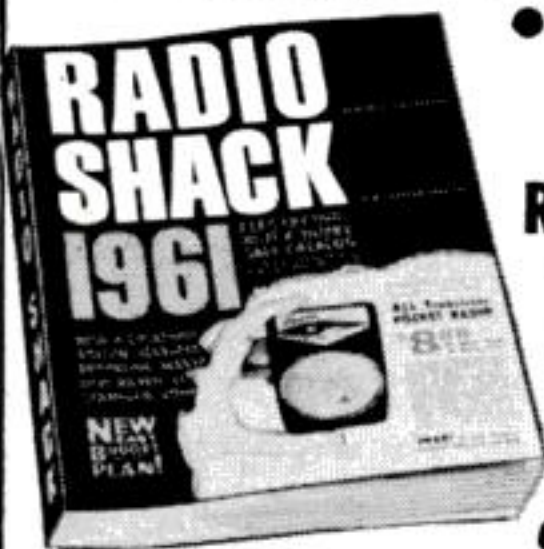
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summer home, my Cadillacs, my Winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.

by Victor B. Mason

Out of the thousands who read this message perhaps only you and a few others will have the vision and the intuition to realize that it may be intended that you read this page at this time—that the coincidence of holding this magazine in your hands may shape your destiny, may guide you to lots of independence beyond the dreams of avarice.

Don't misunderstand me, I am not speaking of mysterious laws of nature that will sweep you to success without effort on your part. That sort of talk is *rubbish*. If this message is intended for you, you are the kind of man who knows that anything worthwhile must be earned. If the earlier development of your karma has revealed to you that there is no reward without effort, you may now be ready to learn and use the secret I have to impart.

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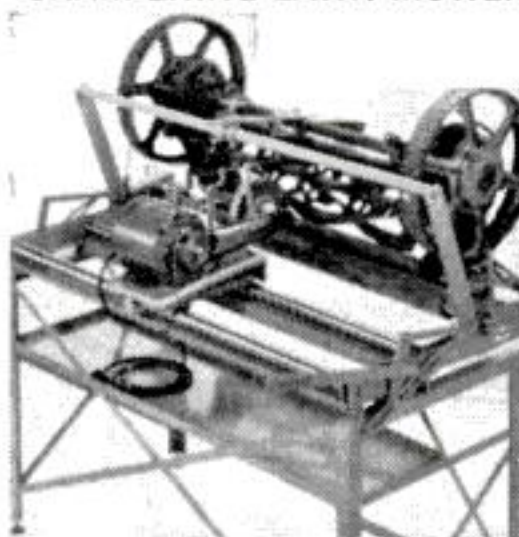
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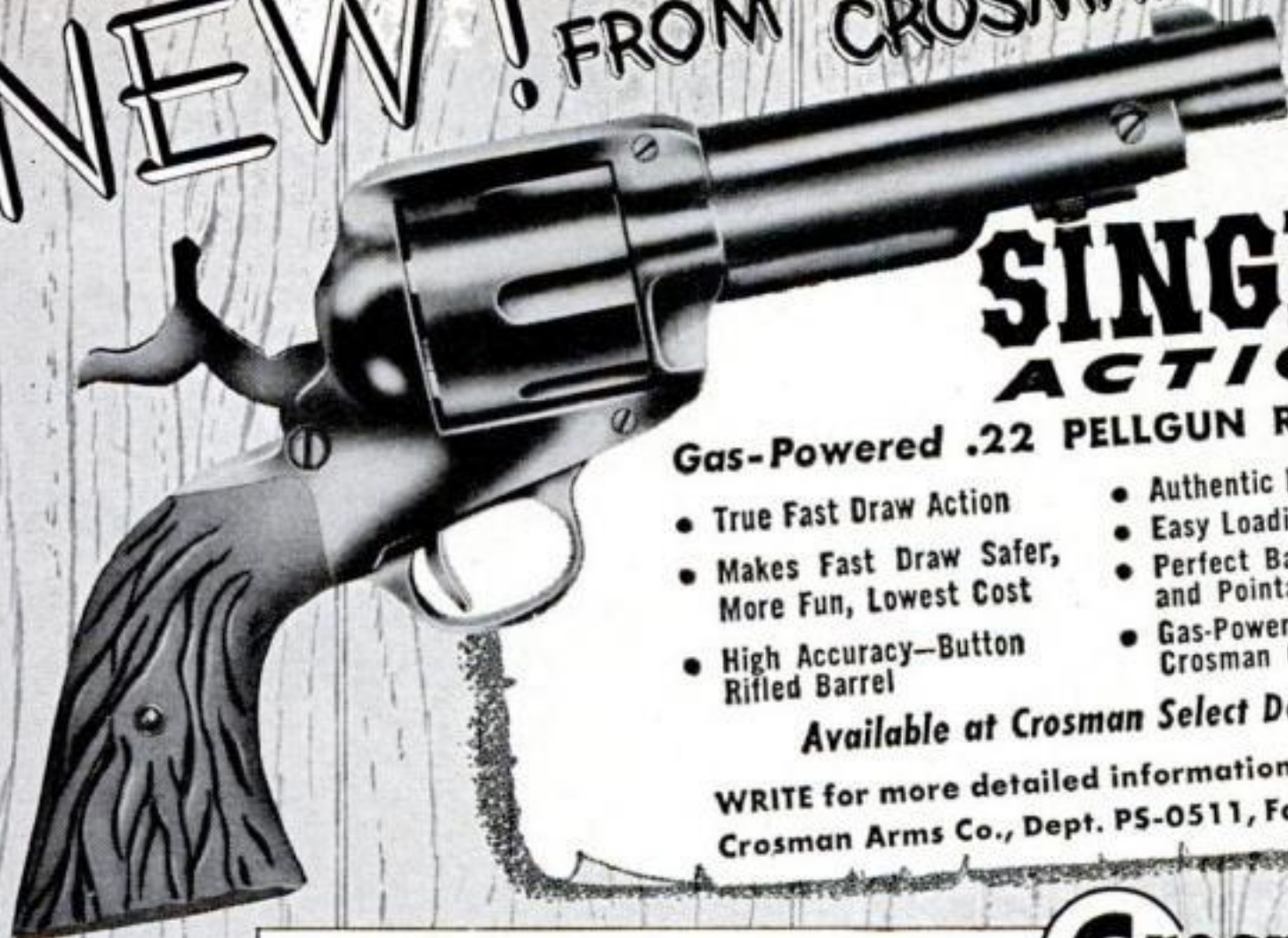
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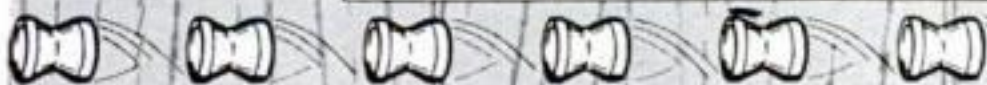
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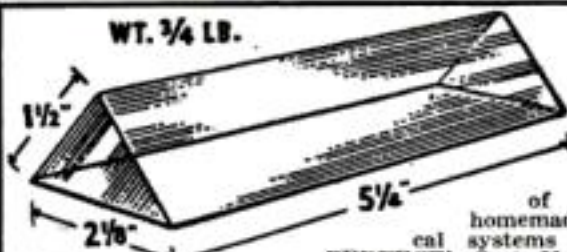
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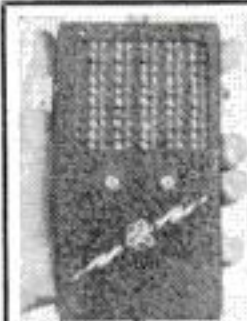
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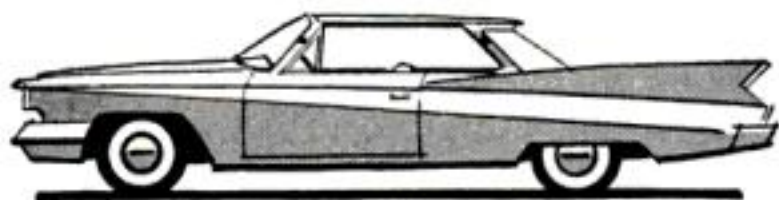
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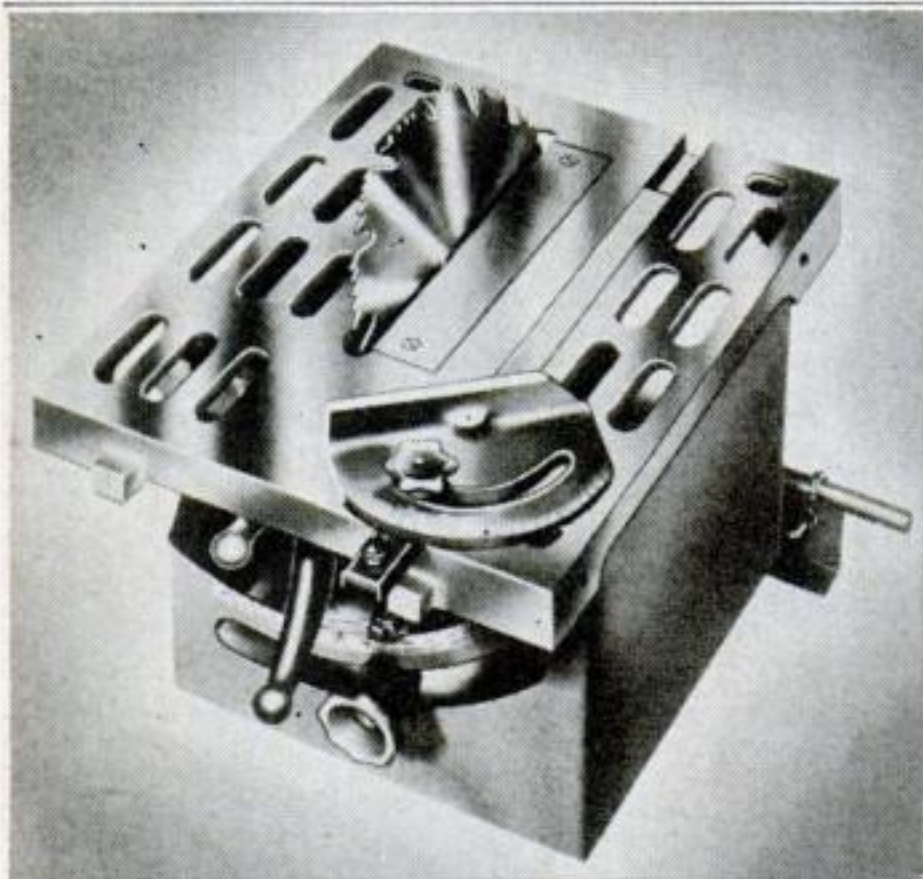
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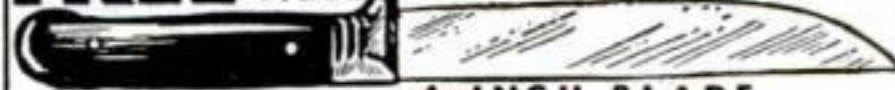
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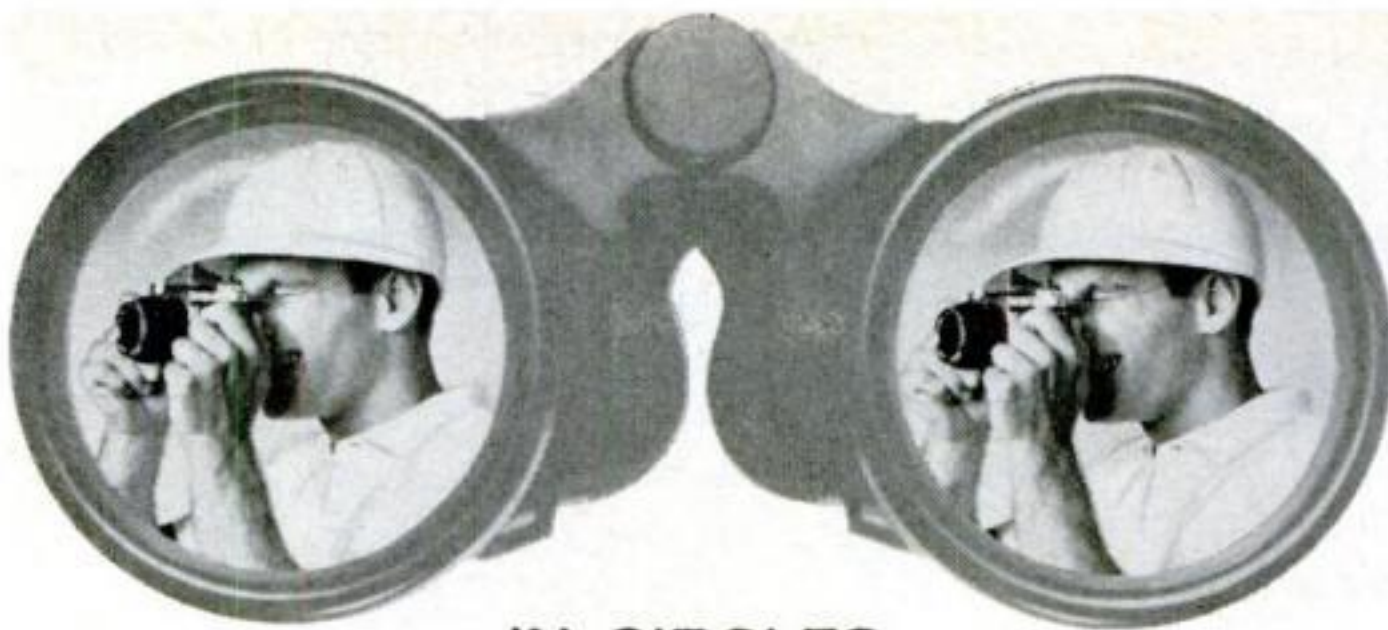
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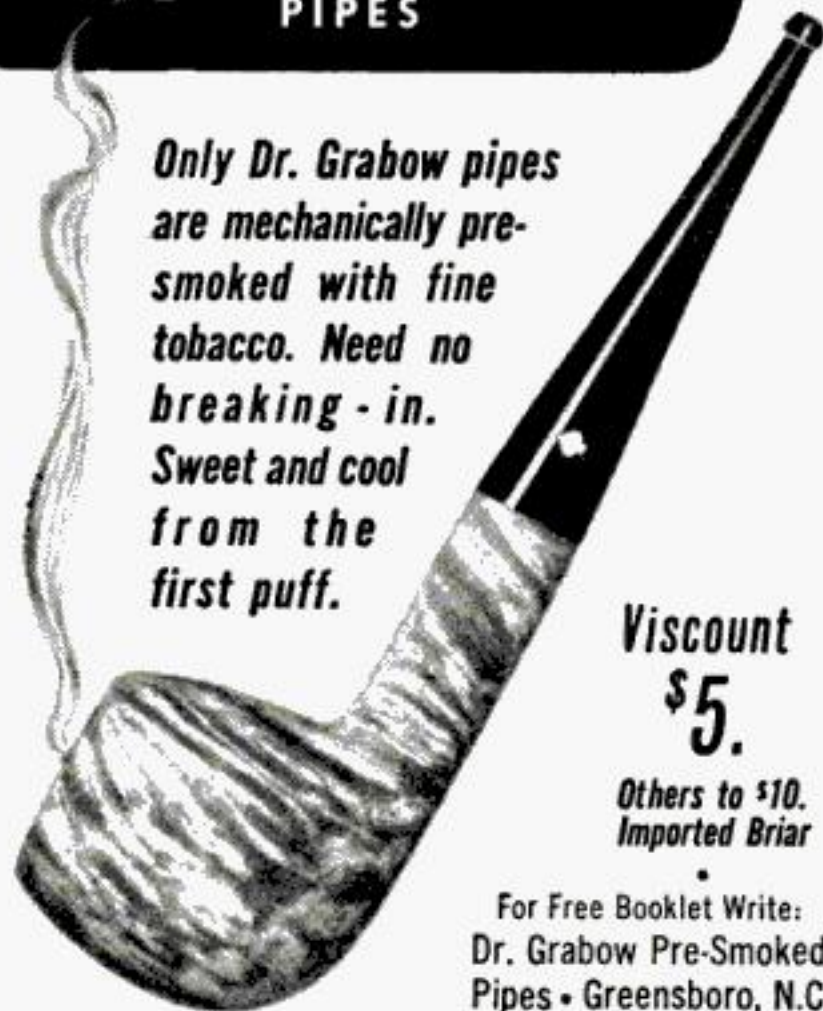
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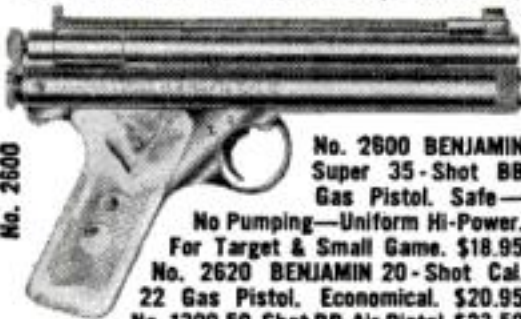
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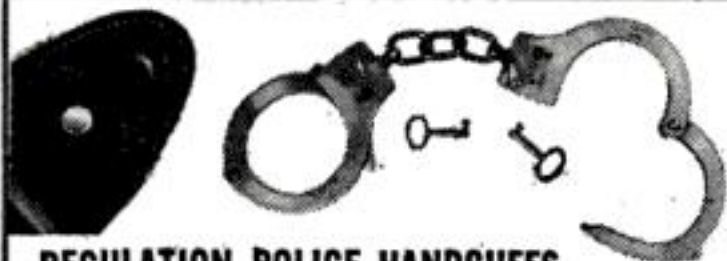
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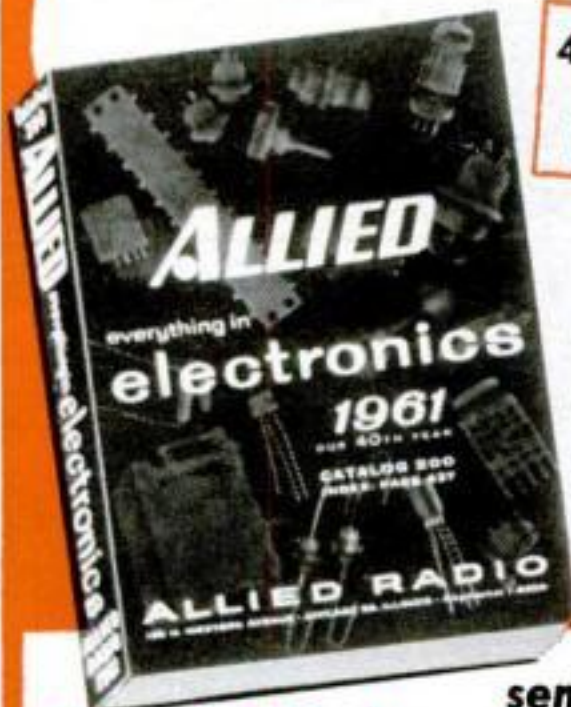
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2

All entries will be judged by The Bruce, Richards Corporation, an independent judging organization, according to how well the project answered a specific requirement and the project's overall inventiveness. All projects are eligible no matter how small. Writing ability and quality of the photograph or sketch are not significant.

3

Prizes will be awarded on the basis of retail value. Only one prize to a family. Trip prize must be taken before Dec. 31, 1961. Judges' decisions are final. In the event of ties, duplicate prizes will be awarded. All entries and contents become the property of Popular Science Publishing Company, and none will be returned. Winners will be notified by mail and a complete list of winners will be published in POPULAR SCIENCE Monthly.

4

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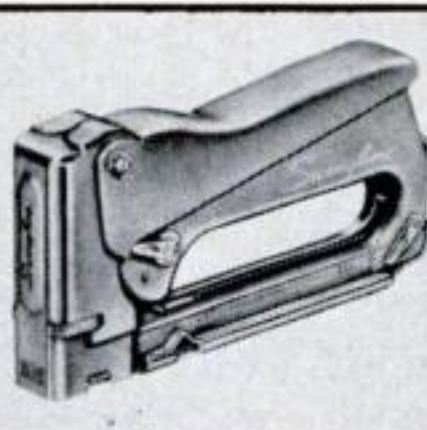
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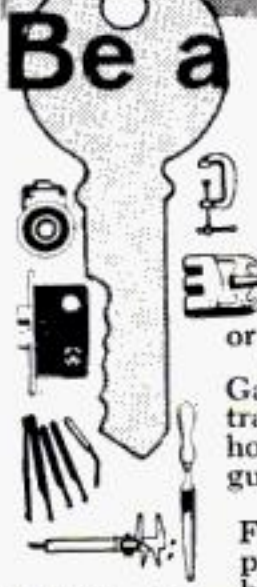
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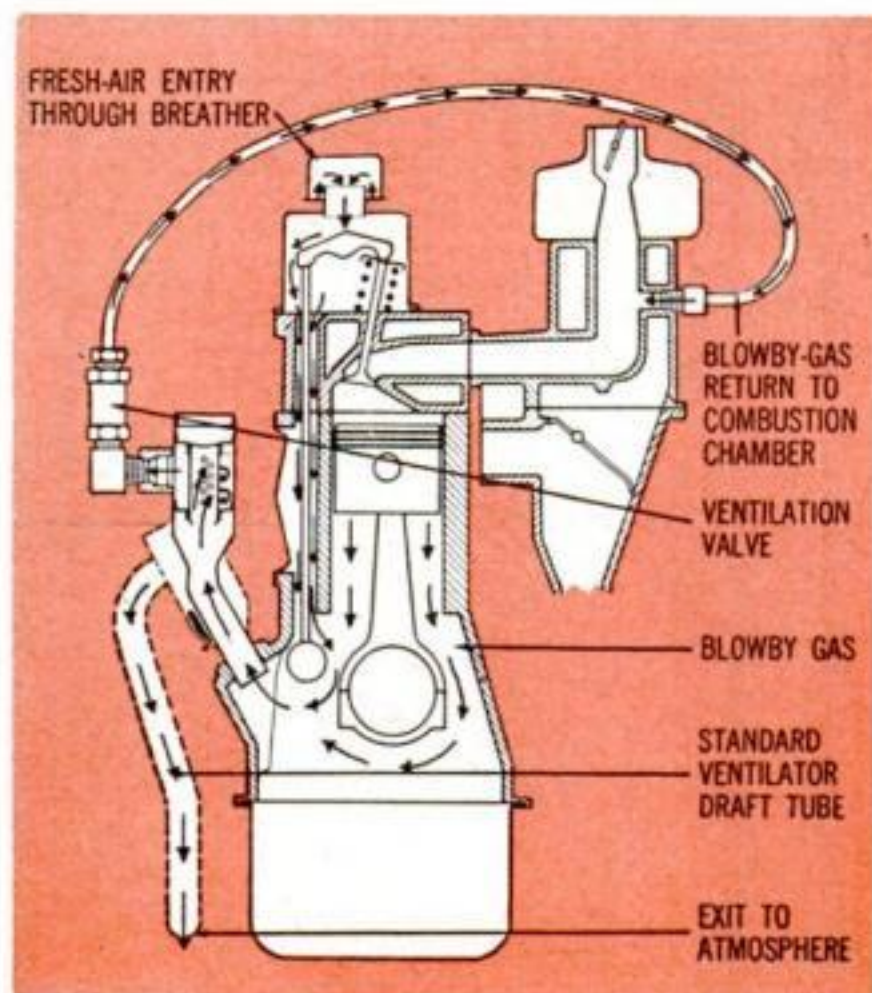
Will Pipe Replace Wire?

LINCOLN'S change from vacuum- to hydraulic-operated windshield wipers for '61 is the latest hint that more and more accessories will be powered hydraulically.

A lot of engineers expect that central hydraulic systems will eventually take over many of the jobs on cars now done by electricity, as well as provide a single power source for hydraulic acces-

sories already in use (power brakes and steering, for example).

Backers of a central hydraulic system claim that accessories operated by it would be both durable and easy to service. And the clincher: A car designed for a central hydraulic system should be cheaper to build than one using miles of wiring and dozens of electric motors, switches, and solenoids.



Anti-smogger is anti-sludge, too. The positive crankcase ventilation systems going into many '61 cars do more than reduce air pollution. They help prevent sludge formation in the crankcase—and may even boost fuel economy.

Unburned gases escaping around pistons into the crankcase mix with the oil to form sludge and corrosive acids. These are a prime cause of engine wear. By pulling the unburned gases out of the crankcase by engine vacuum, the ventilators cut down on formation of the harmful elements. Putting the gases back into the engine to be burned means you get full measure from every gallon of gas.

The ventilators are simple—just some tubing and a valve. GM's AC Spark Plug Division sells them as kits for \$5 to \$20 (depending on make and model), for vehicles bought without them.

Aluminum bumpers on the way.

One major auto maker plans to fit aluminum bumpers on 10,000 of its 1961 compact cars. Follow-up checks on how the bumpers hold up will determine whether the company makes a wholesale switch.

Designers of one medium-priced car are already convinced. They've sched-

uled a midyear switch from steel on all models. (The fact that the accompanying hoopla might add a shot in the arm during a slow sales period has not been overlooked; but here's the real reason they won't offer the aluminum bumpers from the start of the run: They couldn't get enough of them that soon.)

Nylon for gas lines? Experiments indicate that nylon tubing might serve better than metal tubing to carry fuel from gas tanks to fuel pumps. It's easier

to install and service, doesn't have to be preformed, and needs no flexible connections. It won't crimp or dent like metal, either, stopping fuel flow.



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large foot that pushed the machine ahead on its runners. Built and operated by the Road Excavating Co., in Wisconsin, it made about five m.p.h.

This form of traveling heavy equipment was abandoned when the caterpillar tread came along. And now look!

F. H. CARLSON, Brandon, Minn.

It's a Topsy-Turvy World

THE upside-down bridge that turns out to be concrete-pouring forms [July p. 111], reminds me that there really is an



inverted bridge in Germany. This picture I took proves it. It shows a railroad bridge built near Dillenberg.

J. L. CRANE, Sebring, Fla.

"I Feel You Loud and Clear"

IN JUNE ["The Month in Science"] you say that Air Force technicians "are now working the bugs out of a mechanism to send messages to pilots through their skin."

I thought you'd be interested to know that I was probably the first to do this, and wrote an article on it for the April, 1920, issue of *Electrical Experimenter*.

H. GERNSBACK,
Editor
Radio-Electronics,
NYC.

We're not surprised that Mr. Gernsback beat the Air Force to touch communication. He's justly famous for anticipating science (his story "Ralph 124C," published in 1925, gave detailed descriptions of nylon and radar).



No sound—1920 dancers hear music through skin. © 1920, Hugo Gernsback

The Arrow Through the Glass

IN THE PS Favorite for August, you told how to drill through a glass goblet to insert an arrow. I'm bewitched, bothered, and bewildered—and I still don't know how to drill through the glass. You said, "Drill holes in glass with brass tube and abrasive grit." Could you elaborate?

JAMES PUMMER, Wickliffe, Ohio.

Chuck a piece of brass tubing in an electric drill or drill press, cover the area of the glass to be drilled with a paste of kerosene and an abrasive grit such as valve-grinding compound. Hold the rotating brass tube against the glass, adding abrasive as needed. Don't force the work; the tubing will grind its way through if you take your time. Practice on a scrap of window glass first.

... I TRIED my luck on that goblet with the arrow through it. On my first try I busted the glass while drilling. So I got another glass, tried again, and made it. Now I had to carve an arrow and get it through the holes. After carving a beautiful one, I put it in the vise to squeeze it small enough to go through. *Crackkk!* So I tried again.

I now have a very nice arrow-pierced goblet. But to those who are still trying: Soak that arrow before putting it in the vise. Then leave it in the vise overnight. It works swell.

KEN BRUST, Midwest City, Okla.

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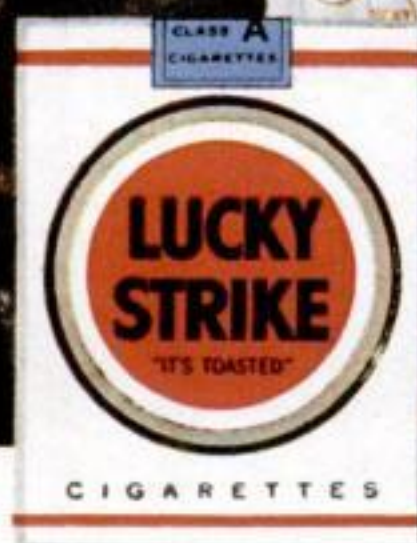
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Big-muscled crawler tractors now get out the stone faster and cheaper than dynamite

**POPULAR
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Steel-Clawed Cats Rip Rock to Pieces

By Harry Walton

SHATTERING rock with diesels instead of dynamite is the big breakthrough in earthmoving today. Crawler-tractors so powerful they can sink steel teeth into stone literally plow rock into rubble.

The controlled bellow of the huge engines is silencing the boom of explosives on job after job—and doing the work faster and more cheaply than the big



In tough going, a single huge tooth is used to tear out and break up hard rock.

CONTINUED

67

Weight and brute power force steel teeth into stone



1 **HYDRAULIC POWER** lowers rippers until rear end of tractor is raised off ground.



2 **TUGGING IN LOW GEAR**, tractor's pull and weight sink teeth into breaking rock.

3 **TWIN RIPPER TEETH** leave broken fragments small enough for scraper loading.



bangs ever could. Rock ripping not only eliminates the costly blast-shovel-load routine, but also its dangers.

In the Chicago area, a stone quarry was paying for damage in nearby residential areas after almost every blast. Now the work of freeing stone is all done with three Caterpillar D9 tractors—and only rock is broken.

Near Needham Heights, Mass., blasting to widen the Charles River would have threatened a bridge. Ripping with tractors got the rock out safely.

Blasting would have endangered a church at a new interstate highway near Kansas City. The contractor ripped out a big sandstone formation. It worked so well he abandoned blasting on the rest of the job.

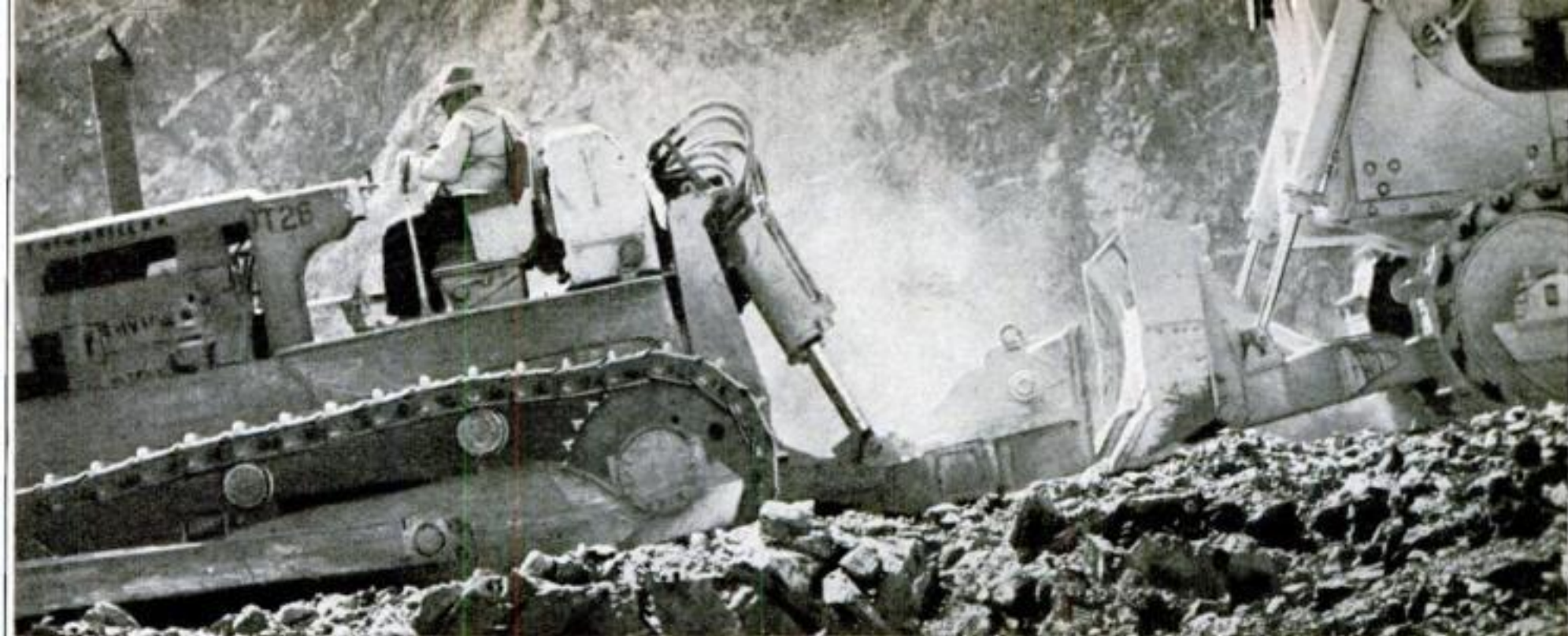
Hidden rock is the joker that can turn a construction job into a nightmarish gamble. An unsuspected layer of stone under topsoil can breed ulcers in strong men, turn profit into bankruptcy.

To dislodge such stuff and break it into haulable size formerly meant moving out dozers and scrapers to bring in an altogether different task force—rock drills, explosives, power shovels, and trucks, plus men skilled in using them. And blasting is a discontinuous process—you drill, charge, fire, load, and haul—then start all over again. Each shot means moving out equipment, halting traffic, warning out workers. All this takes time—while yardage drops, costs skyrocket.

But ripping can be done by the same tractors used for dozing and push-loading scrapers. Ripper teeth can leave rock small enough to lift with those same scrapers—big rubber-tired machines that scoop up material and run with it to a dump or fill area.

Ripping is continuous, with no costly stand-by waits of expensive equipment. Production can run from 200 cubic yards per hour in grim going to 1,500 in easily ripped material. If rippers can do a job, it costs a half to a tenth as much as drilling and blasting.

Ripping is a sight to thrill hardened sidewalk superintendents. I watched a big yellow D9 Cat back into position, stop with its engine gently thudding over. Twin hydraulic cylinders at the rear slowly lowered a massive, hinged U frame. A two-foot-long steel tooth centered on this sank to the ground, bit against rock.



WHEN ROCK IS TOO TOUGH for a single tractor, a pusher unit often makes the job rippable, and

triples working speed. The push block the rear tractor shoves against has rubber springs.

As the hydraulics inexorably continued to drive it down, the rear end of the crawler rose. I could see daylight under the tracks; 15 tons of the huge 30-ton machine was bearing down on two square inches of high-alloy steel point.

Now the 345-hp. diesel bellows with the opening of the throttle. There's a puff of black smoke as the engine runs rich before the exhaust-driven supercharger can ram in enough air. Straining in low gear, the tracks become rigid with effort; drawbar pull and tractor weight put a vector force of 42,000 pounds, or 21 tons, on the ripper tooth.

It sinks in as the machine strains forward. Sharp cracks issue from fractured rock; jetlike explosions spurt from newly opened fissures. Under the intolerable pressure of the man-made claw, stone welded together for millions of years splits asunder, is lifted from its ancient bed, crumbles like furrowed earth.

The Cat moves on, engine roaring, one track or the other slipping at times, clawing for traction as the ripper tooth meets resistance, stubbornly searches out the rock's breaking point, snaps boulders, lifts slabs. Its progress is punctuated by cracks and snappings; the rock "smokes," as construction men say, with the powder of its disintegration.

It's low-gear work all the way. A single ripper tooth is used in hard rock or stuff that tends to break out in big slabs. Two and three teeth are used in easier going or to break already ripped rock into smaller pieces.

Tractors with direct drive are more effective in ripping than torque-converter machines; they fracture rock more readily because of the shock loading of the uncompromising clutch. The converter cushions drive engagement, as in a car.

The history of rock ripping goes back to the Roman Empire, whose road builders mounted a plowlike contraption on wheels, pulled it with oxen to loosen soil ahead of hand shovelers. Similar tools, some without wheels, were used in railroad work as far back as 1860. On the Hoover Dam project in 1931, R. G. LeTourneau put wheel-mounted rippers to



SLICED THROUGH A HILL that runs to a tough 60-percent rock, this 23-foot cut and all other sections of Bypass 117, near Roanoke, Va., were made by ripping and scraper loading.

CONTINUED



SAME TRACTOR that rips out high rock can bulldoze debris downhill, where it can be used to build a shelf or level a hillside roadway.

work behind tractors. They weighed only 7,500 pounds, were clumsy to maneuver, and easily stalled the modestly powered tractors of the day.

It's today's big crawler-tractor, heavy enough to make the ripper tooth penetrate, muscular enough to drag it afterwards, that makes rock ripping feasible. Despite its early dawning, the technique is still so new that, as one ripping handbook puts it, "the laws are being written right now."

Three shanks at a time can tear up old asphalt and other blacktop four inches thick, while a single ripper tooth has broken up concrete up to eight inches thick, slicing through the reinforcing rods inside at the same time.

A more unusual use is the ripping of rock-hard frozen ground, which otherwise would bring construction work to a stop. In Minnesota trials, tractor-mounted rippers have stripped ground frozen to a depth of eight feet.

Strip-mining for coal is already well established. A single huge shank making two or three passes, with the tooth a foot deeper each time, breaks seams up to a depth of eight feet, leaving coal ready for grading at the tippie.

On a mountain near the Kentucky-Virginia border, rippers are tearing up a sea bed of silica. The material, shipped off for glassmaking and other industrial uses, is so hard on ripper teeth that they have to be changed daily. On rock, teeth last for 50 or 60 hours; on one job in tight shale, tip life was more than a thousand hours.

Not all rock can be ripped. Rippability depends not only on the kind of rock, but on its formation and consolidation—the way it's put together.

Igneous rocks (granite, basalt, pumice),

formed by the hardening of molten material from inside the earth, are toughest to rip. Sedimentary rocks, created by the action of water, wind, or glacier action, are among the easiest. Limestone, sandstone, and shale are examples of these. Metamorphic rocks (gneiss, slate, quartzite) are those that have been transformed by pressure, shear stresses, chemical action, freezing and cooling.

Rock lying in layers, or with natural fractures and faults, is easier to rip than solid stuff. Weathering may transform or decompose even granite and other tough igneous rock to rippable condition. That's why taking a sample with a core drill doesn't tell the whole story. Even very hard rock may be rippable in certain formations.

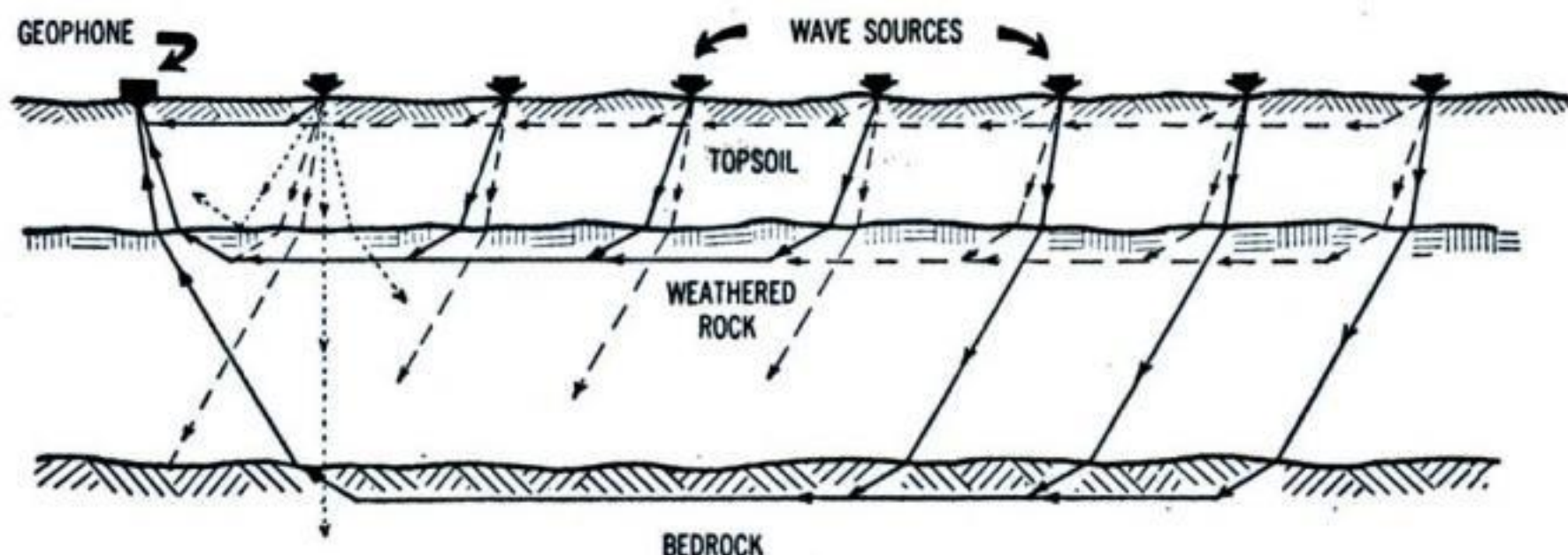
Shock waves are the tip-off. The refraction seismograph, a portable instrument, tells what's under the topsoil and whether it can be ripped. By charting the speed of seismic waves, the device tells where rock is, how hard, whether it's stratified or fractured, decomposed or weathered. For good measure, it tells how far down bedrock is, and in some cases where water level lies.

A shock wave for testing is generated by a sledge hammer hitting a steel plate on the ground, or by a small explosion. Seismic waves travel fastest in hard rock, slowest in loose soil, and at different, though overlapping, speeds in every type of subsurface material in between. Speed of travel is read in milliseconds by an electronic circuit that lights up a row of



RIPPING FIVE FEET DEEP in two passes, a D9 strip-mines coal. The ripper attachment weighs nine tons. Single tooth is far back so that raised slabs won't lift the tracks with their weight.

How shock waves tell what kind of rock lies under the soil



SHOCK WAVE IS SENT at 10-foot intervals. Near the geophone, it arrives first through soil, at 1,000 feet per second. Farther away, it travels faster by detouring through weathered rock at

3,000 f.p.s. At 50 feet, quickest route is through bedrock at 6,000 f.p.s. Solid lines show fastest paths. Plotting time against wave sources tells experts the hidden underground story.



SEISMIC TESTING RIG includes an electronic timer, a geophone or wave detector, a sledge, a steel plate, and wire. Neon bulbs in binary order record time intervals to $\frac{1}{4}$ millisecond.



SLEDGE STRIKES PLATE laid on ground. Impact trips a circuit that starts the timer. Arrival of first earth wave stops it. Neon bulbs remaining lit show the elapsed time interval.

neon bulbs arranged as a binary counter.

If the seismograph gives the nod to ripping, machines can move in to do the job. If it says no, there remain two possibilities before all-out blasting is resorted to. One is to "pop" stubborn rock with modest, widely spaced explosive charges and then follow with rippers and scrapers.

The second, more heroic, method is tandem ripping, with a second tractor shoving against the ripper yoke on the first. Often this not only makes an impossible job feasible, but doubles or even triples production. Adding the second machine—with a boost in operating cost to perhaps \$60 per hour—may pay off very

handsomely in cutting cubic-yard cost.

Tricky as walking on eggs is the widening of roads cut through solid rock over Kentucky's Mammoth Caves. Because of necessary restrictions, bids based on blasting were very high. Ripping has already started the job, in some places tearing up sandstone to a depth of 20 feet.

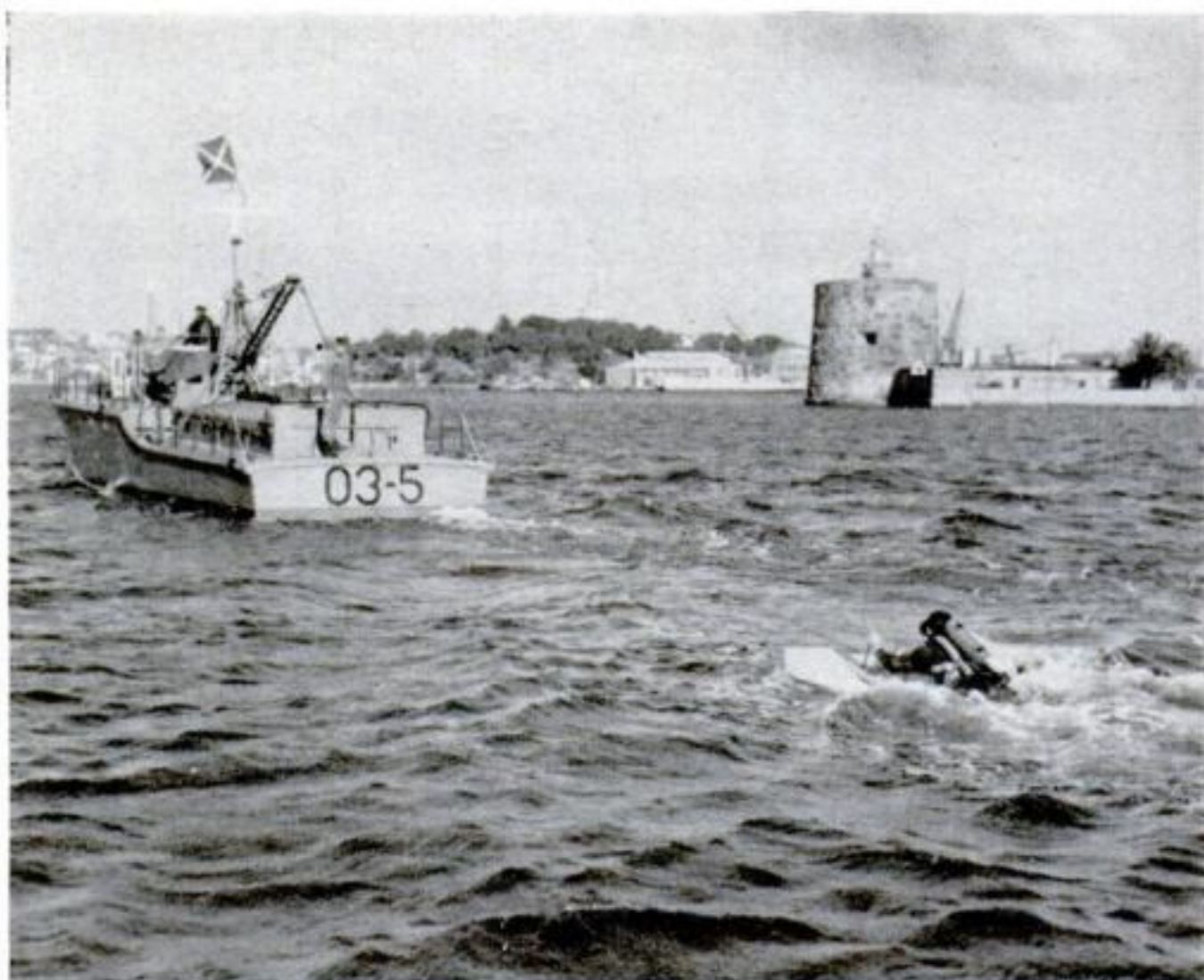
This winter, D9 rippers and scrapers will claw out sandstone and limestone directly over cave areas. Here, blasting could send thousands of stalactites crashing down, perhaps irrevocably destroy beautiful underground formations. For rippers, it's just another—slightly more ticklish—job.

Underwater bat-wing ski

Hydroplanes at the sides of this odd-shaped ski board (far right) let skin divers explore the bottom of Sydney Harbor in Australia as well as skim the surface.

With hydroplanes tilted down in front by two hand-held levers, divers can go down to 80 feet; they climb by reversing the tilt. The ski board also makes turns, underwater barrel rolls, and other maneuvers.

The Bat was built by two skin-diving members of the Royal Australian Air Force Air-Sea Rescue Detachment. With it they have located equipment lost overboard and sunken boats. Towed by a crash boat, they could reach a disaster scene quickly and begin search operations.



FLAT ON HIS SKI BOARD, the skin diver above is towed on the surface by a crash boat. The red-and-white crossed flag on the mast indicates that diving operations are in progress.



Marine of the future

This bug-faced creature is a U.S. Marine demonstrating possible future combat dress and equipment at Quantico, Va. Wearing experimental protective clothing for atomic, biological, and chemical warfare, he carries a light flame thrower.

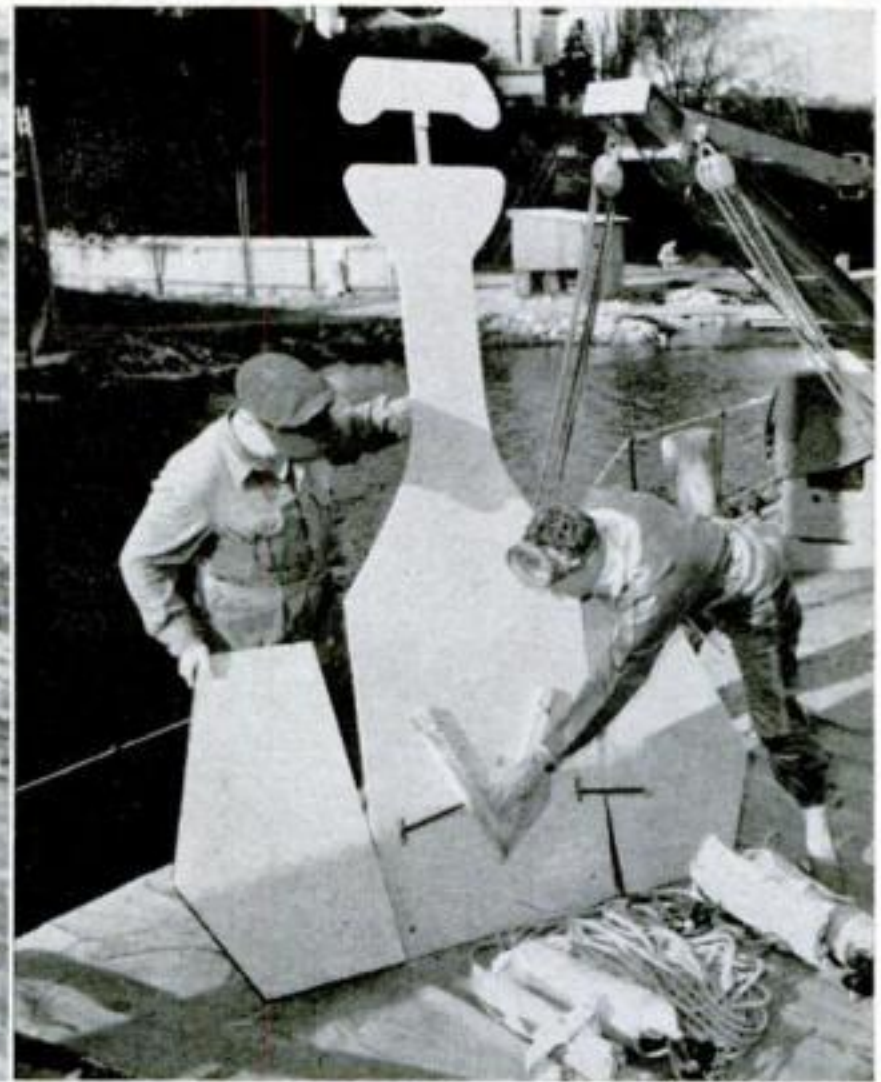


Aircraft umbrella

All-weather protection for crews working on advanced electronic systems in the twice-as-fast-as-sound Republic F-105D fighter-bomber is provided by this fiber-glass canopy. Lights are built into the shelter for dark days and night work.



GOING DOWN: A push forward on hand levers tilts hydroplanes at the board's sides for a dive. Usual cruising depth is about 30 feet.



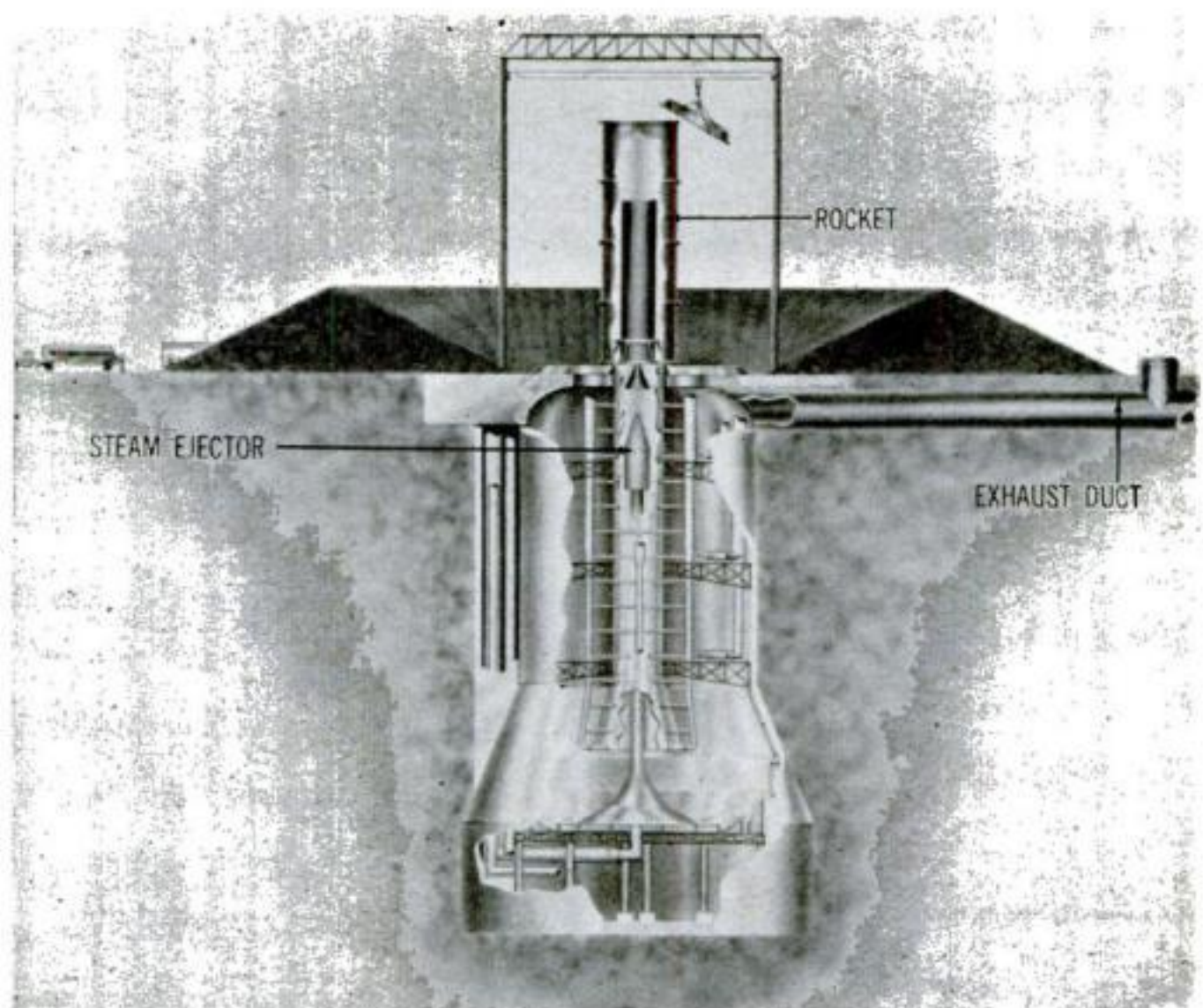
OUT-OF-WATER VIEW of Bat shows hydroplanes and hand-controlled levers. V-shaped plastic shield diverts rushing water from diver's face.

Wind tunnel sits on end

Upper-stage space-rocket engines will soon be tested in their normal vertical flight position — instead of in horizontal wind tunnels.

The Air Research and Development Command's Arnold Center in Tennessee is now constructing a vertical cell capable of testing both liquid- and solid-propellant engines with 500,000 pounds of thrust, expects to have it ready in 1962.

The cell shown in the drawing is designed for modifications that will later enable it to handle engines of 1,500,000 pounds' thrust. The rocket is



above ground; the bullet shape below it is a steam ejector that creates a vacuum that simulates altitudes of 100,000 feet.

Will a Hungry World Raise Whales for Food?

One scientist's solution to feeding people in the 21st century: underwater ranching with the sea's mighty cattle

By Arthur C. Clarke

(From *The Challenge of the Sea* [83.95]; Jolt, Rinehart, and Winston, Inc.)

IT IS not surprising that scientists have asked one another, "Is there any way to farm the sea, and thus improve its productivity, as we have done on land?" The answer may well determine the future of the human race—or even decide whether it has a future.

There is one possible way of exploiting the creatures of the sea that is as thrilling and dramatic as anything that has ever been done. This is the protection, breeding, and herding of the mightiest animals in the world—the whales.

For whales are cattle, even though they weigh a hundred tons or more. This has long been recognized in the use of the terms bull, cow, and calf in connection



WHALE MEAT already is prized in Japan, where it is marketed like this.



That thrashing tail

with them. They are intelligent creatures who can communicate with each other by underwater sounds, so it should not be difficult to direct and control them, perhaps with additional help from electric fields. Most of them are docile—even playful—except when attacked. Then some have been known to hit back and even to sink small ships by ramming them.



POLLACK WHALE



BLUE WHALE

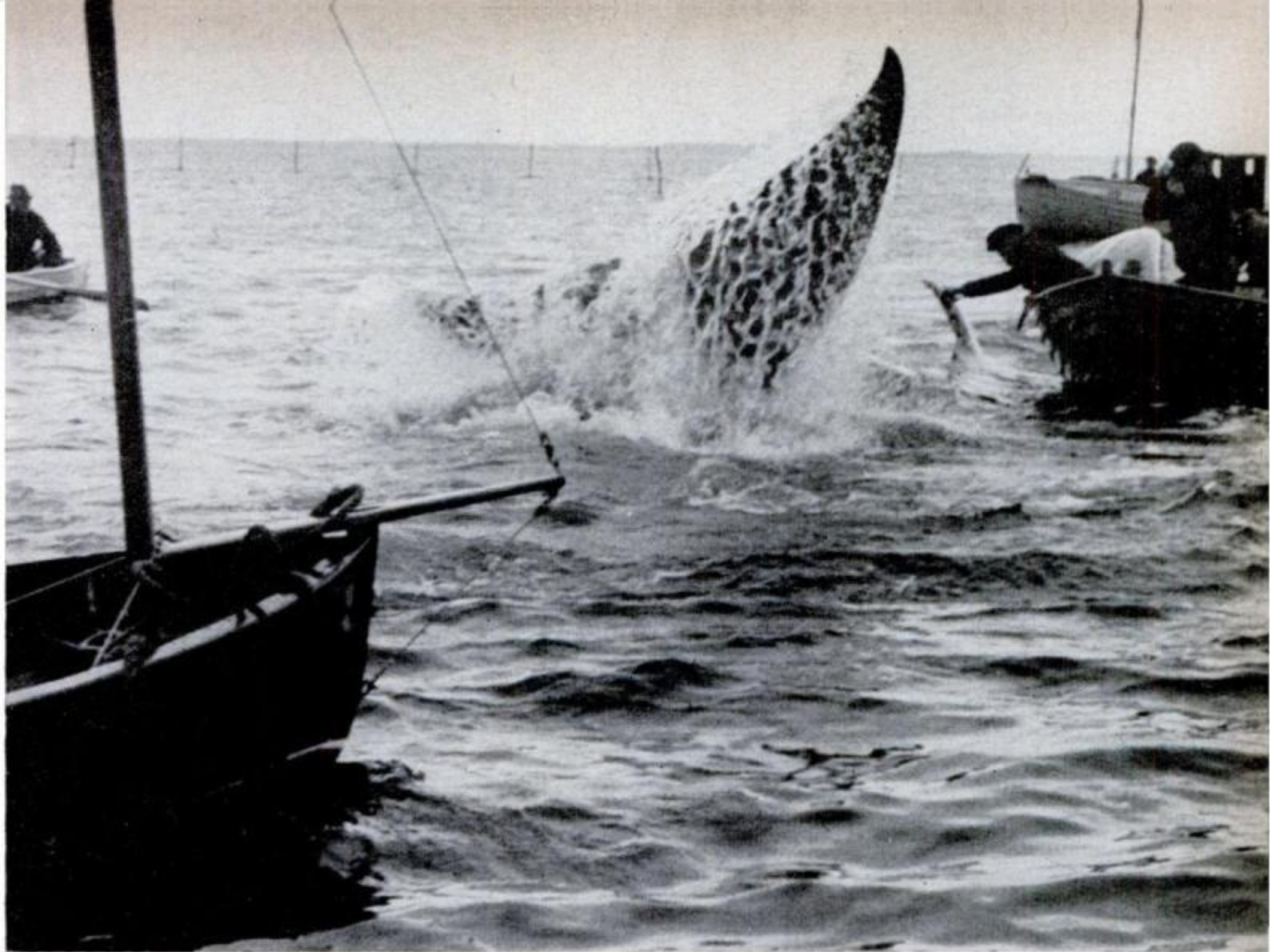


NORTH ATLANTIC
RIGHT WHALE



LITTLE PIKED WHALE

Ugly but docile as cows, these baleen whales roam from arctic to equatorial waters every year.



marks a stranded whale. Such sights might be common if men were to herd whales like cattle.

Some 50,000 of these great animals are killed every year, providing valuable oil, meat, and other food products. You may never have eaten whale meat, but when properly prepared, it tastes very much like beef. The Japanese regard it as a great delicacy, and one day other nations will do the same—if only because more familiar kinds of meat will be getting steadily scarcer and more expensive.

No host to Jonah. There are two entirely different types of whales. The largest and most numerous are the “baleen,” or “whalebone,” whales, which get their name from the hanging curtains of whalebone (baleen) that fringe their mouths in place of teeth. They live almost exclusively on small shrimplike creatures, which abound in countless billions in the cold Arctic and Antarctic water, where



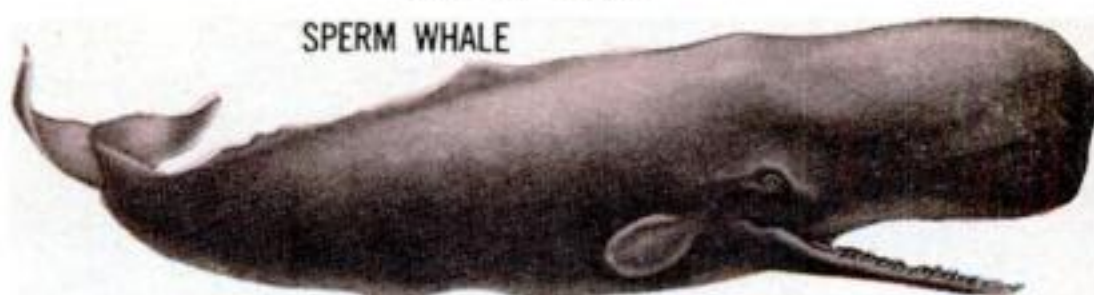
HUMPBAC WHALE



FINBACK WHALE



PYGMY SPERM WHALE



SPERM WHALE

Whale that gobbled Jonah was not a baleen but, probably, a sperm like the one in the corner.



MISLED BY PILOT WHALES, who should have known better, 65 of the huge mammals in 1954 were caught by a receding tide and beached, giving Danes a foretaste of whale farming.



WELL WORTH CATCHING for their meat and oil products, whales can bring as much as \$30,000 apiece.

the sea's crop of plankton is the richest. Straining their living soup through their built-in filters, the baleen whales have no need of teeth, and despite their huge size, their throats are only about six inches in diameter. So none of them could have swallowed Jonah.

Very different is the sperm whale—the original Moby Dick of Melville's great novel. He does not feed on two-inch shrimps, but upon one of the most terrible creatures of the sea. Diving to depths of half a mile or more, the sperm whale hunts the giant squids in the eternal darkness where they live, chewing them up alive despite their efforts to defend themselves with claw-studded tentacles and vicious parrot beaks. Although most of the squid eaten are relatively small—less than six feet—fragments of tentacles 30 feet long have been found in the stomachs of sperm whales.

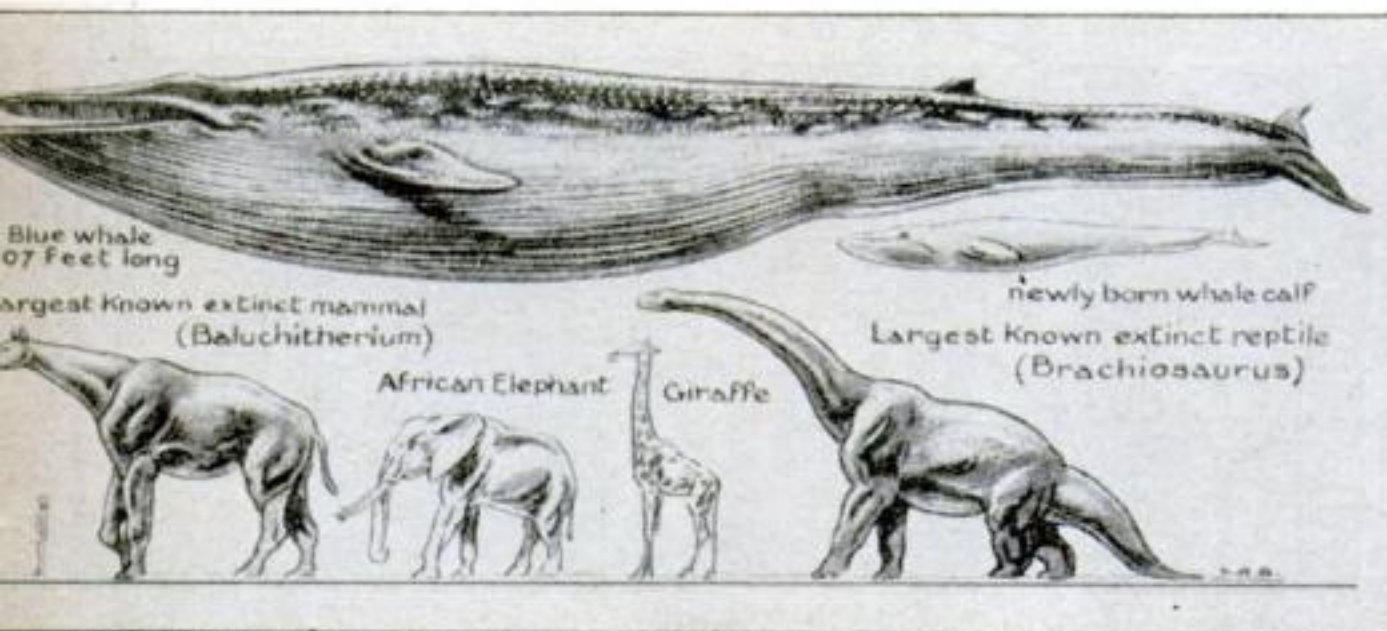
The sperm whales live mostly in the warm seas around the equator, but the baleen whales migrate every year in one of the greatest animal movements on the

face of the earth. They spend the summers in the polar regions, feasting on the rich crop of plankton life that flourishes as the sun rises higher in the sky. At the end of the summer, gorged with the tons of food they have consumed, they move toward the equator so that their calves can be born in warm waters.

Biggest of them all. The largest of the baleen whales—the blue, or sulphur-bottom, whale—is the biggest animal that has ever existed. Not even the dinosaurs of prehistoric times approached it in size. It grows to a length of well over 100 feet, and although only a few have ever been weighed carefully, the biggest specimens must tip the scales at something like 200 tons.

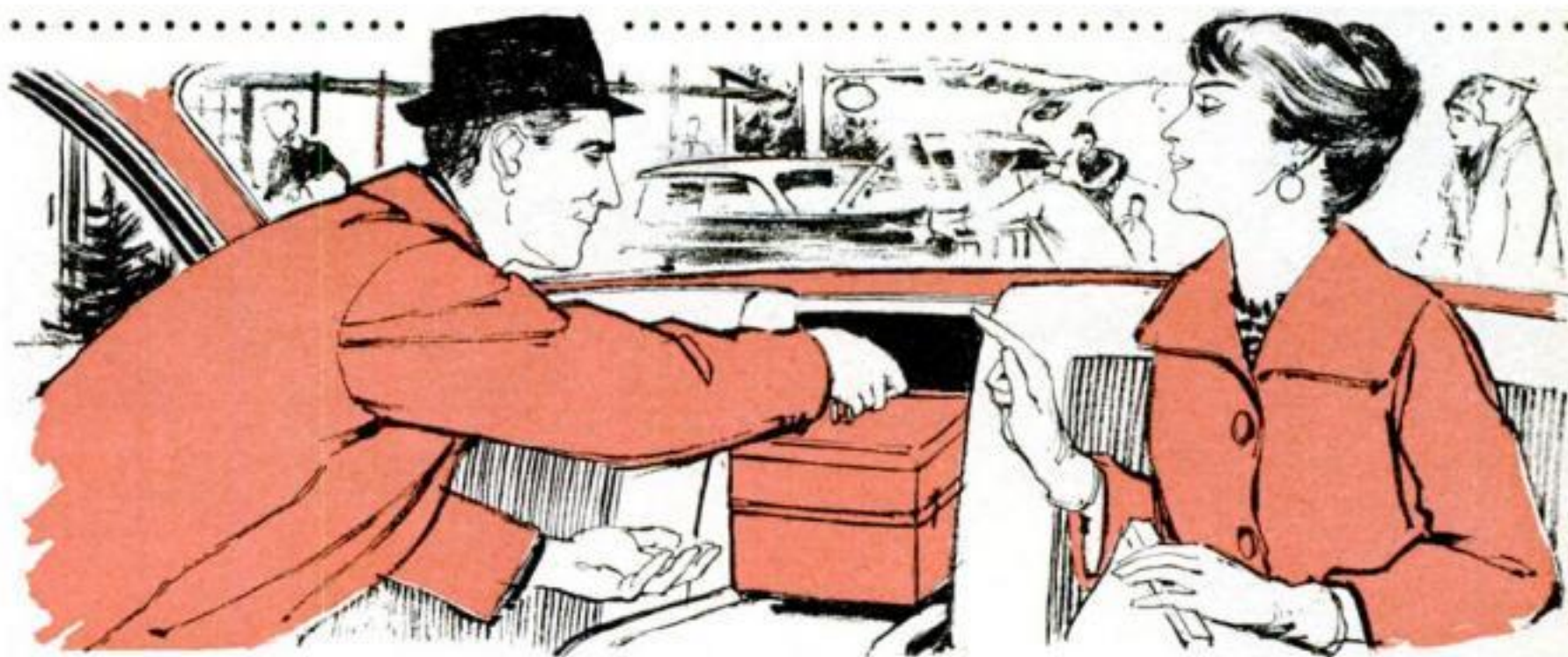
A baby blue whale is about 23 feet long when born and weighs approximately eight tons. It's hard to picture a baby as big as a bus. It's even harder to grasp the rate at which it grows. Feeding only on its mother's milk, the infant takes a mere seven or eight months to become a

[\[Continued on page 216\]](#)



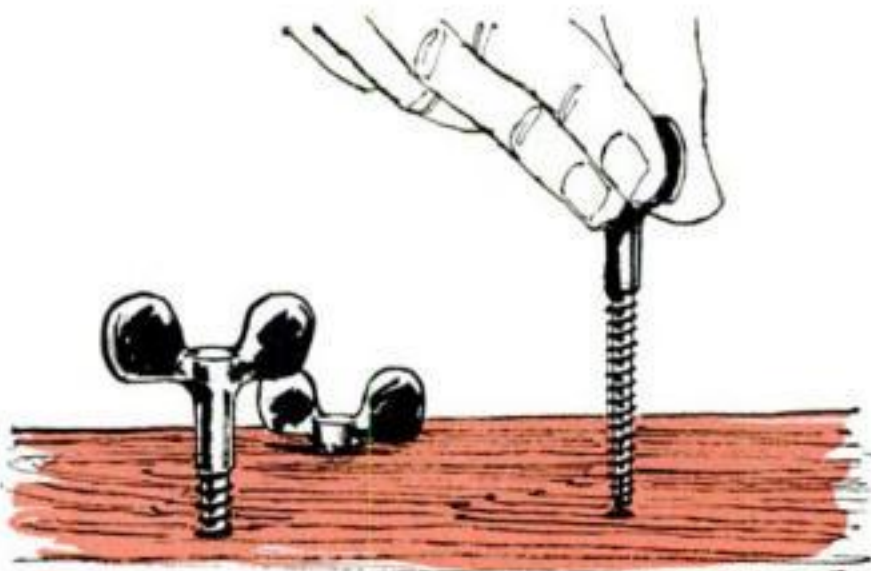
BIGGEST ANIMAL ever known, the blue whale produces a baby 23 feet long at birth, which puts on weight at the rate of 500 lb. a day. This scale drawing and those on the previous two pages are reproduced by courtesy of the American Museum of Natural History.

"I'd like to see them make..."

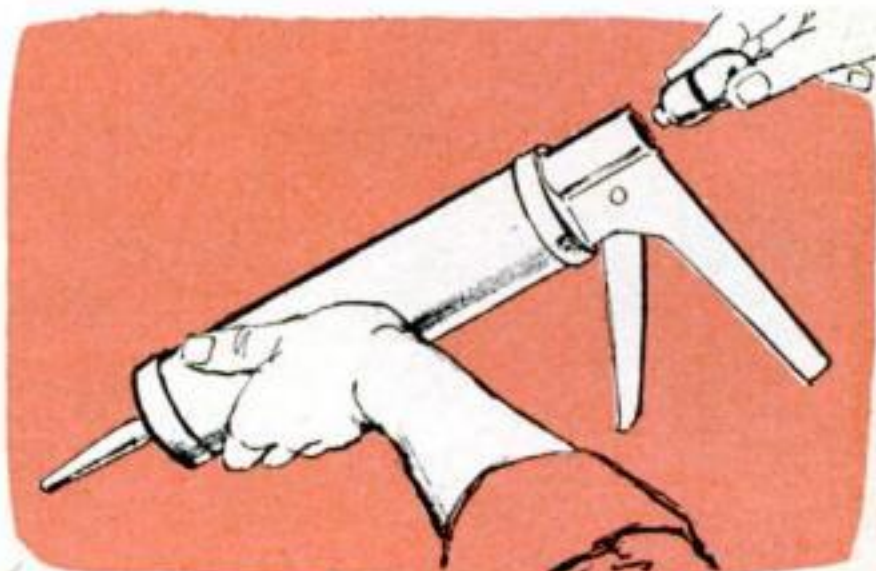


A CAR-TRUNK HATCH hidden away in the back of the rear seat. To reach into the trunk from inside the car to get small personal articles,

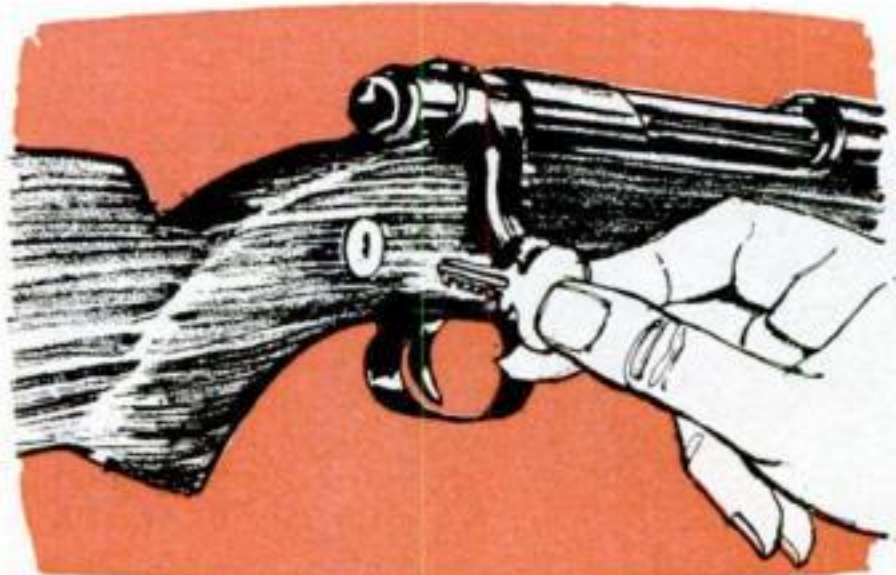
you'd just lower a center armrest. This would expose a sliding door that you'd unlock with a key.—*Stewart A. Collins, Hackettstown, N.J.*



EASY-OUT WOOD SCREWS for the jobs around a shop that call for a temporary fastening. A wing-nut head would be just the thing for quick removal.—*S. N. Stresnic, Fort Lauderdale, Fla.*



NO-SQUEEZE CALKING GUNS powered by gas cartridges. In winter, when the compound is cold and stiff, it takes a strong hand to operate the hand lever.—*Andrew Vena, Philadelphia.*



RIFLES THAT LOCK so they couldn't be loaded, cocked, or fired. A key-operated device would keep the bolt or other firing mechanism from being moved.—*F. E. Martz, Calverton, N.Y.*



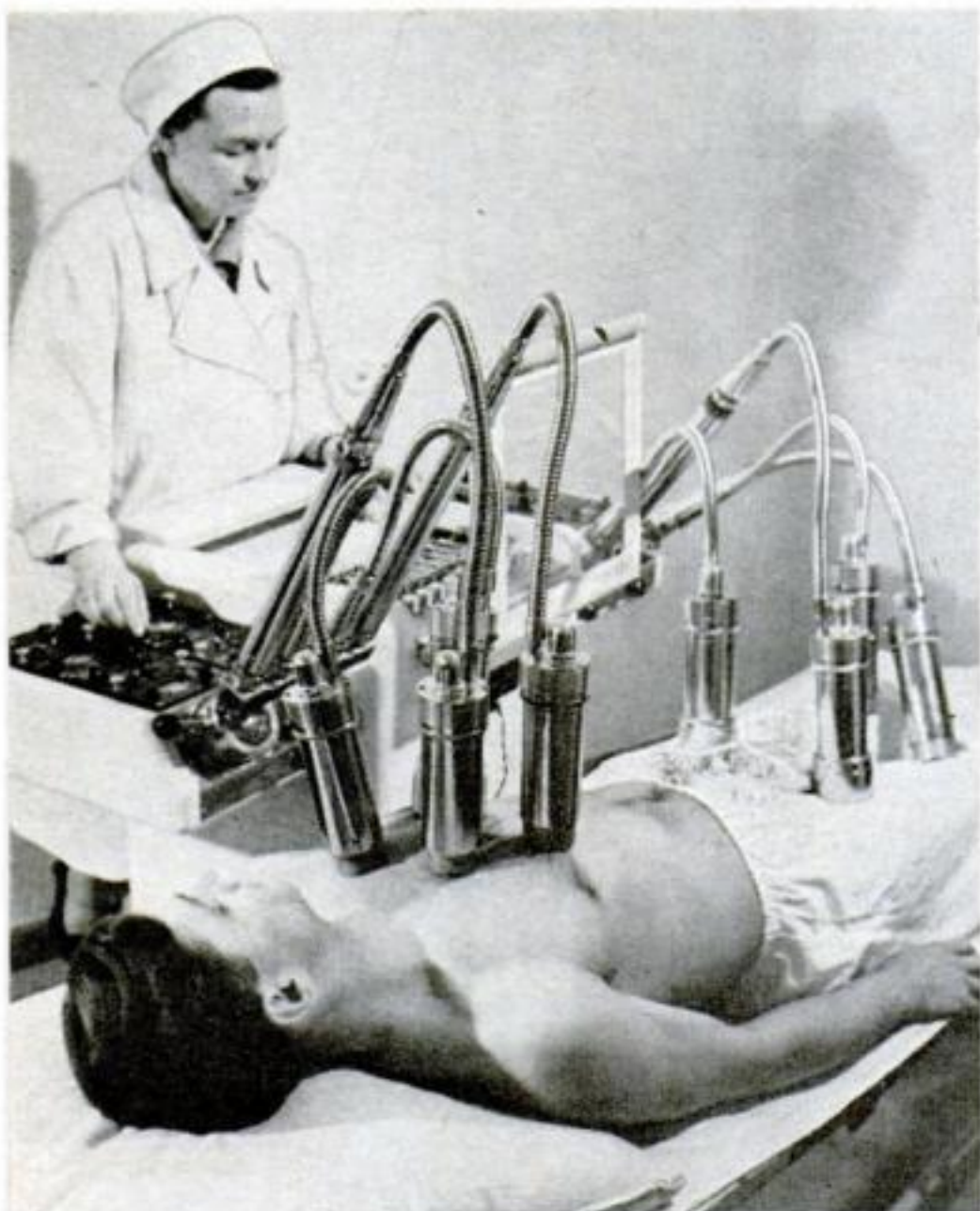
ILLUMINATED DUSTPAN BRUSHES with a flash-light cell pocketed in the handle. Then the user could see in dark closets and under low furniture.—*Fred Lettino, Long Island City, N.Y.*

Everyone has his own pet idea of a gadget that he would like to see in general use. The five ideas illustrated above were suggested by **POPULAR SCIENCE** readers. What's

yours? We will pay \$5 for each one published. Please use Government postcards only. Write name and address clearly. Contributions cannot be acknowledged or returned.

Russians Show Clever New

Soviet engineers are busy solving problems in many fields



BLOOD CIRCULATION is checked at eight different points of the body and registered automatically by this ultra-sensitive radiograph. Individual transceiver heads inject minute doses of radioactive materials into adjacent blood vessels; the flow is recorded on paper tape.



DRUM-LIKE CUTTER on this ditch digger gouges out eight-foot trench. Arc-shaped conveyor belt dumps soil onto bank. The high-speed excavators are in use on a pipeline project that will carry natural gas hundreds of miles through Georgia and Armenia. They're pulled by crawler-tractors.



MULTIPLE-DUTY POWER-FRAME TRACTOR harvests grain, picks potatoes, excavates soft earth, generates electricity, and pumps water. It's powered by a 45-hp. engine that drives all four wheels. It can be converted to a truck by adding a dump body. Top speed is 12 m.p.h.



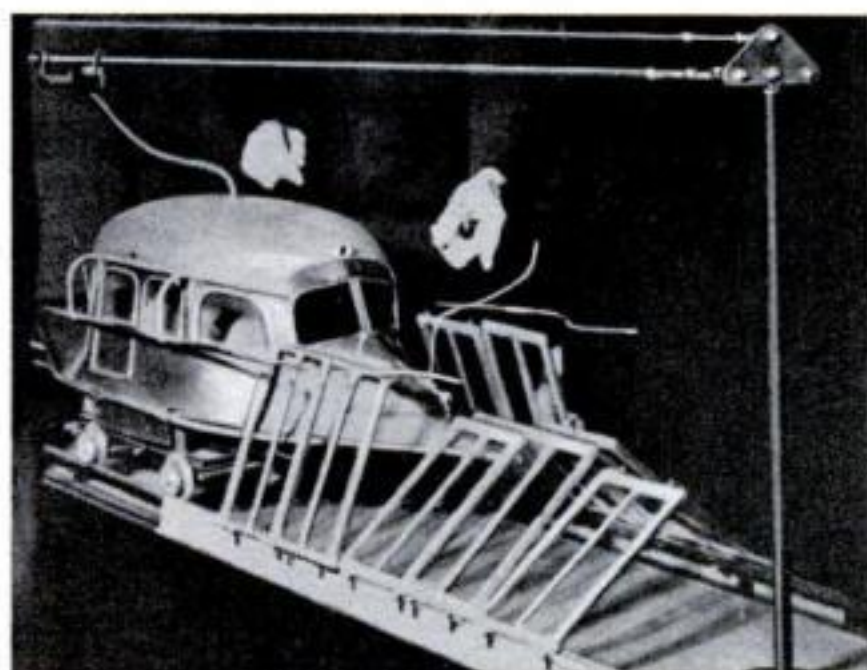
CROSS-COUNTRY TRACTOR rolls on two-foot-wide tires for traction on soft ground. A 90-hp. diesel engine, mated to a transmission with a dozen forward and four reverse gears, drives all wheels. The vehicle does 20 m.p.h. and can haul an eight-ton semi-trailer. It's made in Kharkov.

Machines

—from medicine to gold mining



EIGHTY-HORSE ALUMINUM ENGINE with replaceable cylinder liners powers the Volga station wagon, Russia's newest car. Capable of toting a half-ton of cargo with two aboard, the car has coarse and fine oil filters, built-in lube system, reclining seats, radio, heater, temperature gauges in radiator and cylinder head, and a tool kit of 35 items. Automatic transmission is optional.



CROPS GROWN UNDER GLASS are cultivated by this rail-mounted vehicle. The cowcatcher prow wedges open the hinged panels covering the bed; as the machine passes, a tapered tail eases the panels down. The electric combine sprays, plows, harrows, fertilizes, and harvests.



DOUBLE-TRACK CAR TRANSPORTER for long-distance delivery carries six autos on the top deck and two more, plus spare parts, in the enclosed hull. To unload the upper level, the tractor is jackknifed and the cars are driven down ramps extending from the inclined front end.



FROZEN GOLD FIELDS along the Kolyma River in the arctic regions of northeast Siberia are thawed artificially to permit year-round mining. Hot water, pumped through a grid of steel pipes and carried underground by rubber tubes buried in the summer, softens the frozen crust. Bulldozers then scrape off the surface overburden, exposing the rich sands beneath.

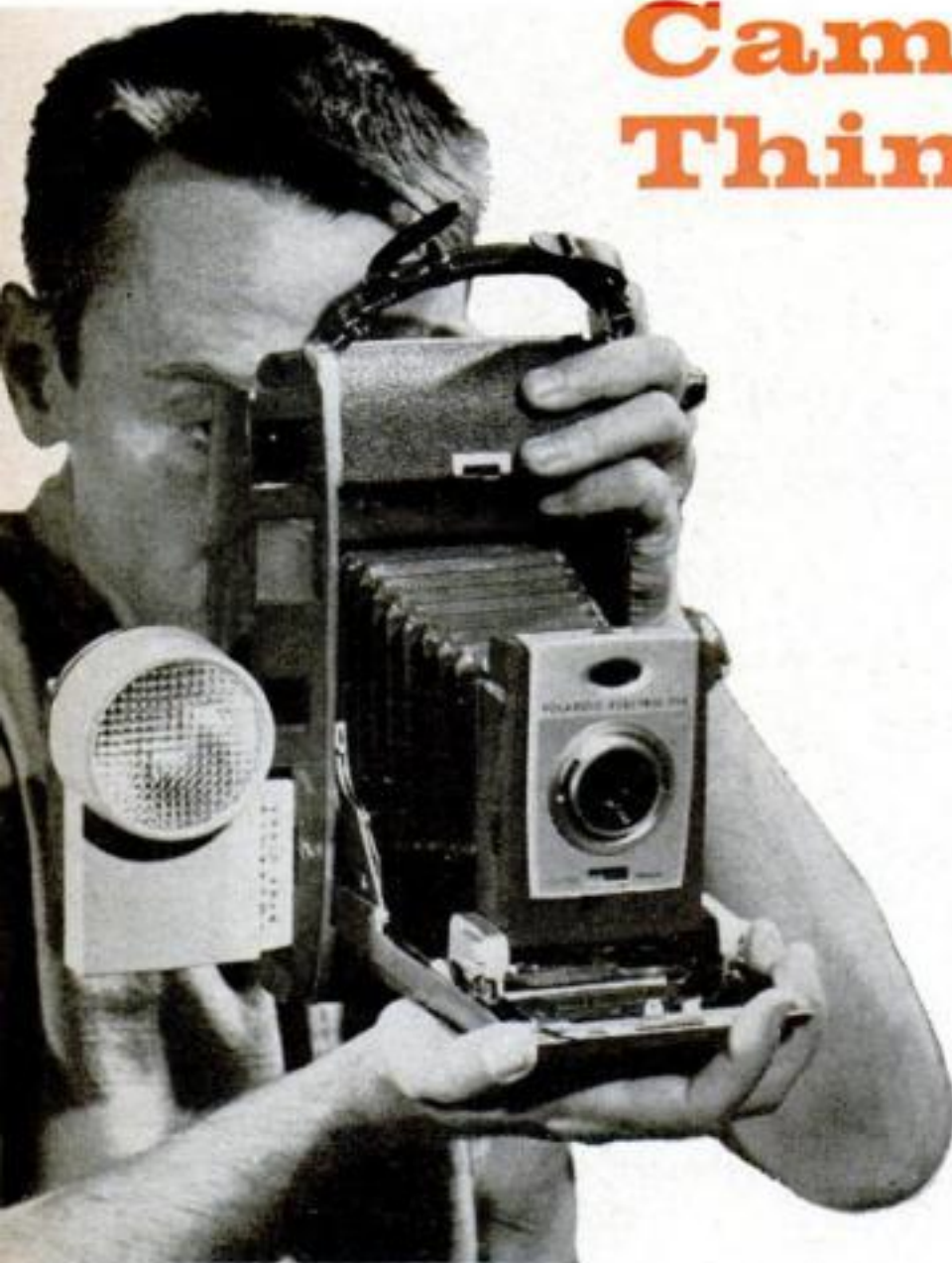


LIFTED ON FIVE-FOOT STILTS, this tractor cultivates corn and other high-standing crops. The hollow rear legs house a chain drive leading from the extended rear axle to the double-reduction gearing on the rear wheels. Front tubular frame incorporates steering shafts.

The latest in fuss-free photography:

New Polaroid Camera Thinks for Itself

By Alfred W. Lees



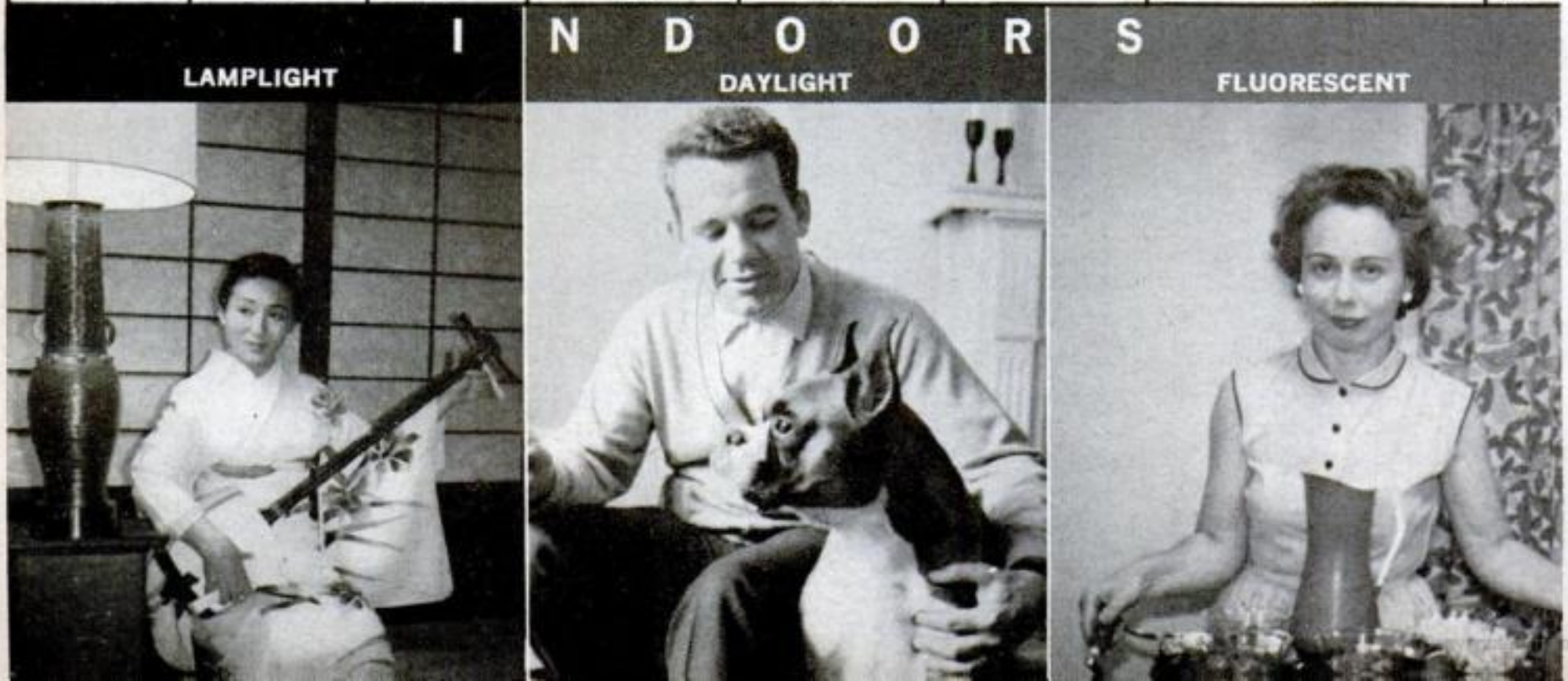
WITH WINK-LIGHT ATTACHED, camera is ready for three types of indoor exposures (below). Shutter is cocked; thumb is on release.

DON'T be fooled by the docile appearance of the new Polaroid 900. It has a mind of its own. When you pick it up, be ready to surrender some of your rights as a photographer. Point it at a problem and this camera opens an eye, calculates, takes a deep breath—then makes all the decisions.

Dissect the shutter housing and you'll find innards such as you've never seen in a camera before. While a miniature concertina times the double-blade shutter, a rotating cam determines how far the diaphragm should open. It's all part of the most automatic shutter ever devised for an all-purpose camera. Up to now, electric-eye cameras have controlled the aperture at a fixed shutter speed; Polaroid's previously introduced photoelectric shutter (a clip-on accessory for outdoor use) adjusts the *shutter speed* at a fixed aperture. The revolutionary electric-eye

Pictures 'round the clock—indoors and out—with these

APERTURE	f/8.8			f/12.5	f/17.6	f/25	f/35.4
SHUTTER	1/12.5	1/25	1/50				
	EV EQUIVALENTS						
	10	11	12	13	14	15	16
	BRIGHTNESS (FOOT CANDLES)						
	.2	.4	.75	1.5	3	6	12 25

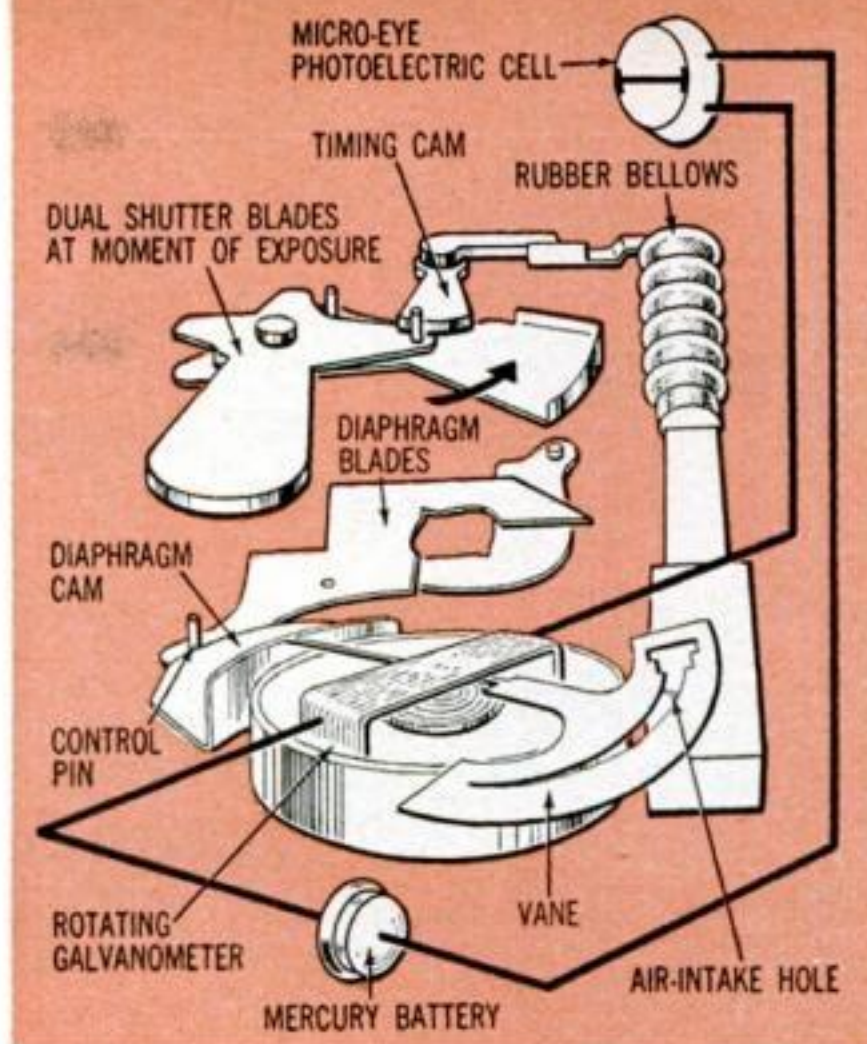


system of the 900, however, controls *both*.

Its versatility is demonstrated in the chart below. With the accessory wink-light, the camera needs only normal indoor lighting. Its eye computes the amount of wink-light fill-in required to soften shadows. In total darkness, the wink-light can be used alone for subjects up to five or six feet away—or a conventional flash unit can be plugged into it.

Sharp to the horizon. When you load the camera, you merely dial the correct film rating into a window below the shutter. The camera handles any speed from 50 ASA up, and will take the new color film Polaroid has promised. All their new films develop themselves in 10 seconds—instead of the minute they once took. For the range-chart snapshots, we used film with a rating of 3,000—the fastest made for amateur use. Shooting in bright sun with film this sensitive, you have so great a depth of field that you don't even have to focus—everything from four feet to the horizon will be sharp. This leaves you, as the photographer, with exactly one function: pressing the shutter release.

Actually, there's a little more to it. For many pictures, you'll have to focus. But, again, the 900 does most of the work. Its combined viewer-rangefinder features a bright frame that shrinks and offsets as the lens moves closer to the subject.



WHEN SHUTTER IS TRIPPED, diaphragm blades open until pin contacts shaped cam that keeps aperture small for bright sun or lets blades flash wide in low light. At same time, vane positions itself over air-intake hole. Tapered slot controls speed with which air enters to extend bellows. Moving end of bellows rotates timing cam on which two shutter-blade pins ride. Pins fall off in sequence, flicking first blade (arrow) away from aperture, second over it to end exposure.

The offset corrects for parallax. A split image fuses in a center triangle to tell you when you're set on proper distance.

Indoors or out. On top of the lens

[Continued on page 220]

automatic exposure settings

f/50			f/58	f/82	
1/100	1/200	1/300	1/600		
17	18	19	20	21	22
25	50	100	200	400	800
O U T D			O O R S		
SHADE			BRIGHT SUN		



Anatomy of the 900



EYE, HEART, BRAIN, AND LUNGS of camera are (left to right): the photo-conductive cell, 1.34-volt battery, moving-coil galvanometer (pointer indicates tapered slot) and shutter-timing bellows.



Look at that circle!

Chevy's compact bus spins about on a 9¾-foot radius, less than half the space a standard car needs. Despite its high body, it leans little in such maneuvers, even when traveling at speeds up to 20 m.p.h.



Here Come

LONGER, LOWER, WIDER, Chevy Greenbrier looks like a slicked-up city cousin beside import that inspired design, the VW Microbus.

Bigger, faster, more muscular than their Volkswagen opposite numbers, Chevy and Ford versions use Corvair, Falcon parts

By Ken Fermoye

IF YOU ever hankered to play a game of bridge in an automobile streaking down the highway at 60 miles an hour, now's your chance.

ON RUTTED BACK ROADS or in cramped parking spots, Greenbrier is equally at home. Weight of its rear engine on driving wheels supplies a

Both Chevrolet and Ford have come up with vehicles that are that roomy. The most radical cars in Detroit's autumn crop, they are kissing cousins of the familiar, slab-sided import, the VW Microbus.

surprising amount of traction. Steering effort is low. Independent springing on all wheels, like that of Corvair sedan, gives soft ride.



Ford's bus is named 'Econoline'

With room for eight, Ford's vehicle towers ten inches over Greenbrier, is wider, but shorter. Engine, a Falcon six with heavy-duty bearings, rides in a well over front axle, drives the rear wheels. Double doors on right side (unlike Greenbrier, it has none on left) provide four-foot-square aperture for passenger entrance or cargo loading. Floor height at curb is slightly more than 23 inches, compared with Chevy's 26.5.



U.S. Minibuses

The Greenbrier sports wagon, as Chevrolet calls its model, and the Ford Econoline station bus both use engines, drive trains, suspensions, and controls from their conventional compact cars, the Corvair and Falcon.

The U.S. counterparts of Germany's Microbus are bigger. They hold more. They've got more power. They go faster. They're more comfortable. And they use more gas.

You can use them for a lot of other things besides bridge-playing: camping,

light trucking, lugging the local Cub pack to meetings, toting four-by-eight plywood sheets. In fact, each of these cars can call the ordinary station wagon, and then raise it in spades.

Chevy's Greenbrier looks like a non-Sanforized Greyhound bus after a wetting. But I drove one of these things and it scampers over rough roads and up rutted hills like a pack mule. It carries nine riders, or a lot of cargo, in surprising comfort.

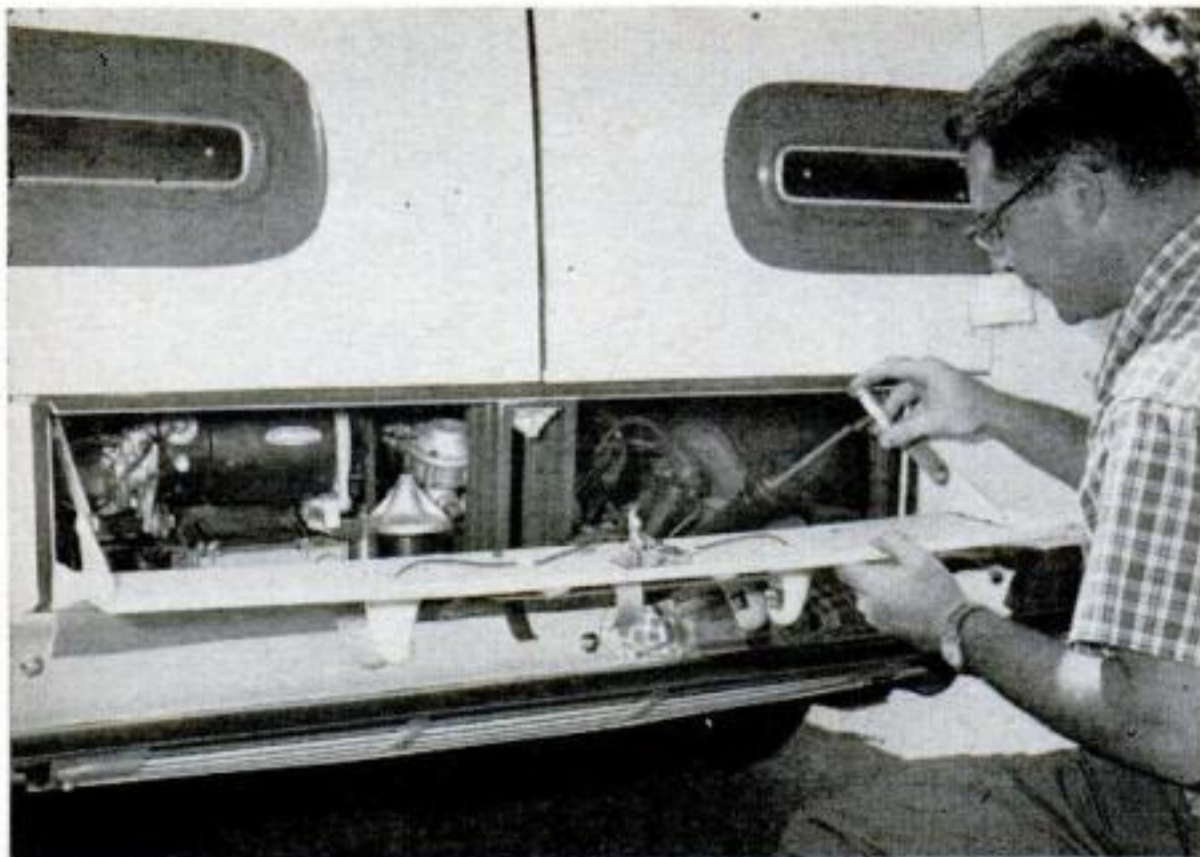
Ford's station bus looks like a scaled-

CONTINUED

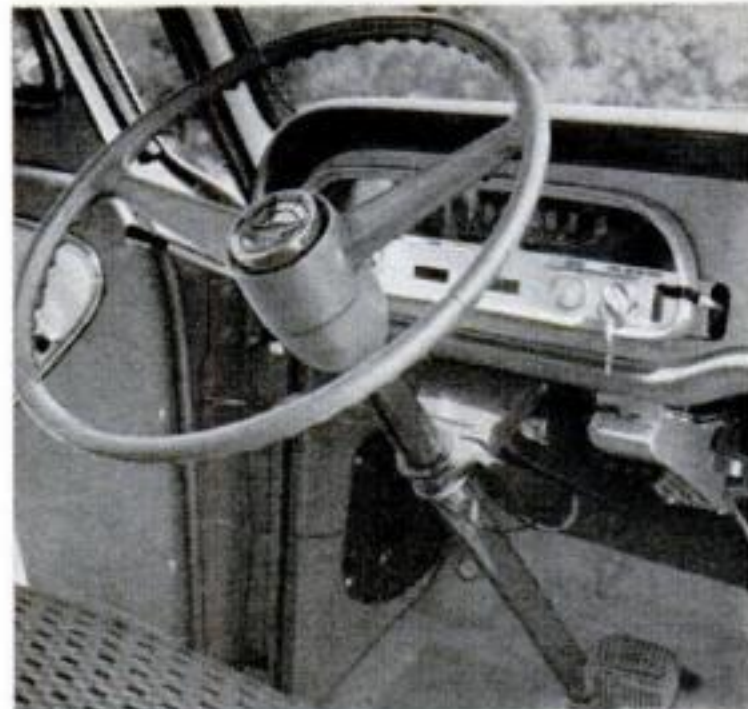
REAR SEATS DO TRICKS in the Greenbrier. Normally facing forward, center bench can be reversed so passengers ride facing each other. For

carting cargo, both rear seats can be removed by loosening four wingnuts. Door openings measure the same size as the Ford's.





FOR CHECKING OIL, rear panel on Greenbrier drops down. A floor section removes for engine repair. Gas tank is under front seat.



COCKPIT looks like what it is—one in a bus. Bench can hold three persons comfortably, and—surprise!—is adjustable for driving ease.

down van with doors and windows punched in its sides—which it is. It's starker and smaller than the Greenbrier; it comes closer to the VW Microbus in dimensions and concept. It seats eight.

The Greenbrier measures almost 11 inches longer than the Microbus; the Ford Econoline bus is a half-inch shorter than the VW, but two inches higher and nearly eight inches wider.

A Chevy engineer, with the expectant air of a proud papa displaying his new progeny for the first time, introduced me to the Greenbrier at General Motors' Michigan Proving Grounds.

"Climb in," he urged. And climb is what you have to do to get into the driv-

er's seat. Tight-skirted gals will find the maneuver awkward.

Once aboard, I found the driving position comfortable and the vision, particularly forward, spectacular. The high seat and hoodless front let you see the ground a bare six or seven feet in front of you.

I fired up the air-cooled, rear-mounted engine—same as the regular Corvair six except for heavy-duty bearings—and slipped the Powerglide shift lever to "drive." (A manual three-speed transmission is standard. The automatic gearbox and a four-speed manual transmission are options.)

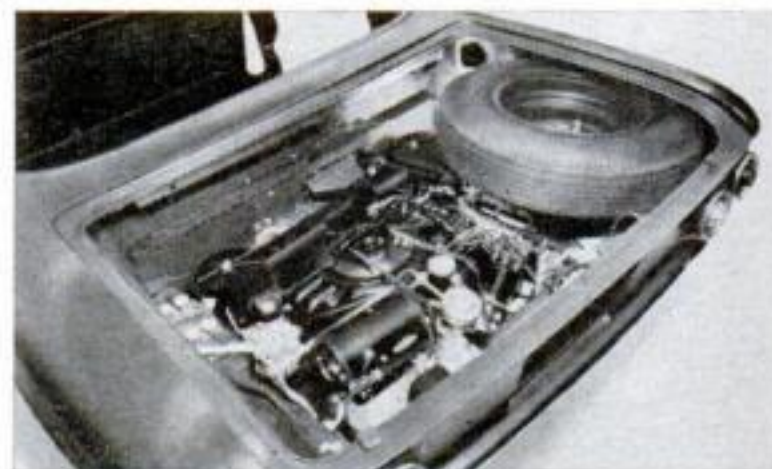
When I cut the wheels hard to the left, the Greenbrier pivoted so sharply

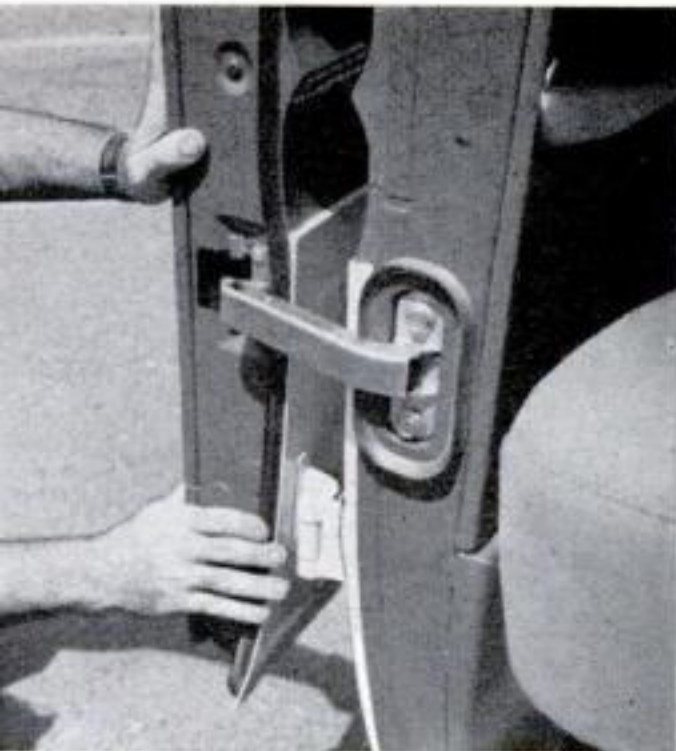
New Corvair sedan carries more luggage . . .



MOVING the spare tire to the engine compartment increases the storage space in the '61 Corvair sedan trunk. The tire fits there because there's a new engine air-intake system. The air cleaner, air tubes to carburetors, and automatic choke

don't stick up over the center of the engine any more. The choke, in fact, no longer is automatic—it's manual. The gas tank holds 14 gallons, three more than in '60. And there's a new type of hot-air heater—optional.





TRICK HINGES slip out of slots in side and rear double doors so they'll fold back flat. Small rubber bumpers protect the body paint.

HOW THE MINIATURE BUSES COMPARE	CHEVROLET SPORTS WAGON	FORD ECONOLINE BUS	VW MICROBUS
LENGTH (in.)	179.7	168.4	169
WIDTH (in.)	70	75.8	68.5
WHEELBASE (in.)	95	90	94.5
OVERALL HEIGHT (in.)	68.5	78.1	74.5
CURB WEIGHT (lb.)	3,005	2,659	2,450
GROUND CLEARANCE (in.)	6.6	7	9.5
DIAMETER OF TURNING CIRCLE (ft.)	19.5	34	39
PASSENGER CAPACITY	9	8	9
CARGO SPACE			
MAX. WIDTH AT FLOOR (in.)	62	65	60
MAX. HEIGHT (in.)	40.2	54.3	55
MAX. LENGTH (in.)	115.5	100.6	105
ENGINE			
HORSEPOWER (@ r.p.m.)	80 @ 4,400	85 @ 4,200	36 @ 3,700
WEIGHT PER HP. (lb.)	37.5	31.2	68

that we almost seemed to be moving sideways. The short wheelbase and generous wheel housings, which allow the front wheels to turn through a wide arc, give the sports wagon an exceptionally short turning diameter, just 19½ feet from curb to curb. The Microbus needs twice that space and the big Chevy wagon uses 41 feet for the same maneuver.

You can U-turn in the average city street without backing and filling. And you can park the Greenbrier in spots just a foot or so longer than its own length.

A trip over a winding, black-topped road used for testing trucks demonstrated that the new Chevy doesn't have the abrupt, choppy ride common to many vehicles

with so short a wheelbase. Its four independently sprung wheels iron out small bumps and take the harsh jolt out of big ones. It does rock fore and aft slightly over wavy surfaces, with a kind of bilowy motion that might be uncomfortable for anyone prone to car sickness.

The Greenbrier wandered a bit when a quartering breeze hit it. I suspect you would have to tend strictly to your steering in a stiff, gusty crosswind—but this is typical of high, flat-sided vehicles. Otherwise, the steering was a delight, with nothing bus-like—except the rather horizontal position of the steering wheel—or heavy about it.

[Continued on page 238]

... and now there's a station wagon, too



A NEW Corvair station wagon carries its engine right where the sedan does—in the rear. The car seats six. With the second seat folded down, cargo area measures 77 by 57 inches. The loading door is 27 inches from the ground, only

two inches higher than that of the standard Chevy wagon, despite the under-floor engine. The engine's power rating remains at 80 hp., but an optional 98-hp. engine is available, as it is in the Corvair sedans.



First new Rambler American in 10 years is shorter and narrower, but inside it's just as big.

Small Rambler Gets Even Smaller

LESS than two years ago, George Romney, the bouncy president of American Motors, called in Ed Anderson, his chief stylist, and said:

"Our Rambler American hasn't changed looks since 1950. It's getting dated. Design me a new American that will be good for another 10 years."

It was a tough order. The car had to be sleek but conservative, fashionable but not faddish.

Early this month the new American appeared. It's five inches shorter, three inches narrower, and an inch lower. Yet it's got just as much room inside as the old one, plus a trunk that's half again as big—the floor is lower, the lid is higher and flatter.

That's not all that has happened to the

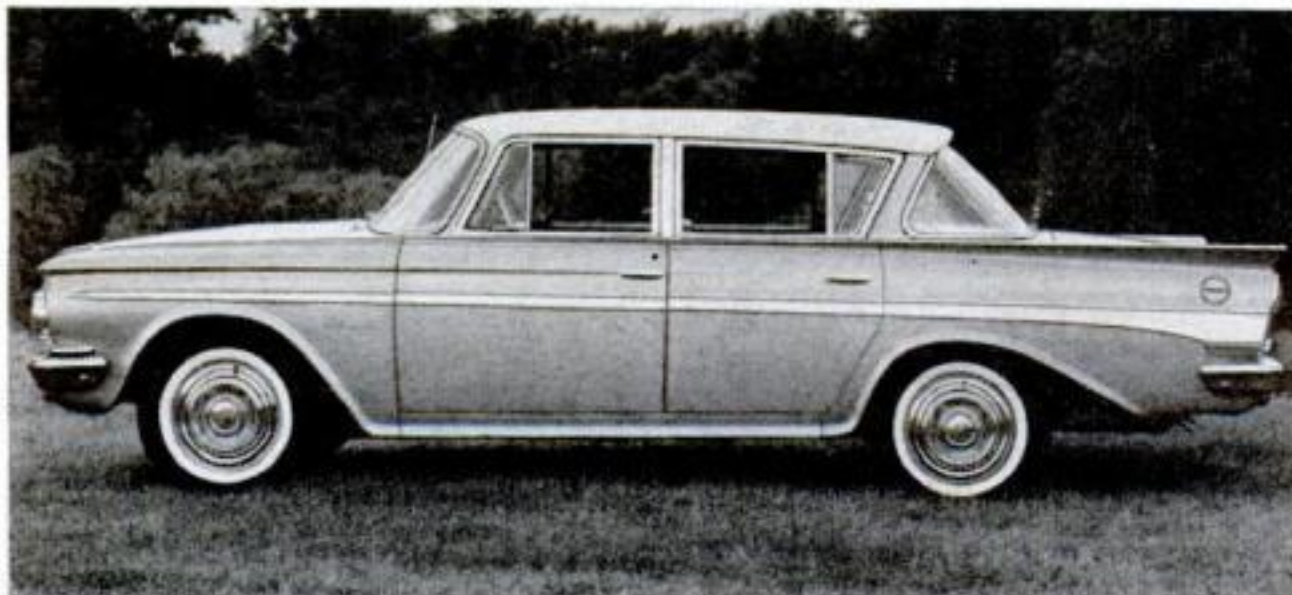
Rambler family for '61. The bigger, regular Ramblers have a spanking new six-cylinder aluminum engine to offer. Their looks have improved, too.

But the American is the big news.

Stylist Anderson chopped it to its new size by slimming doors, flattening the roof and sides, and lopping off overhang. Crisp lines with sculptured accents replace the old bathtub look.

The 127-hp. overhead-valve six, inherited from the bigger Ramblers, powers the top-priced Custom series. The aged 90-hp. flathead goes into Super and Deluxe models—with the hotter engine optional.

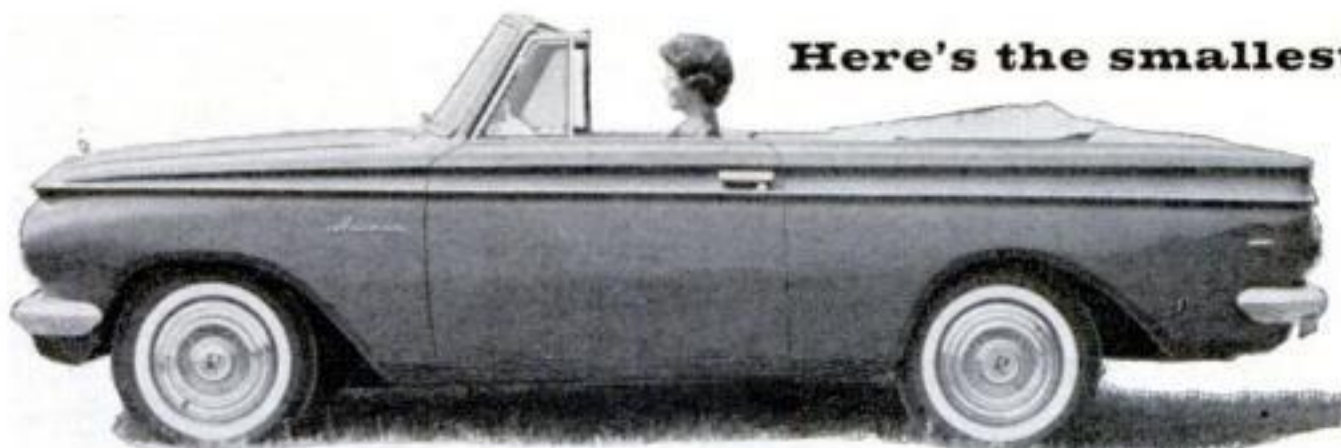
The regular Ramblers sport a new snout, a new die-cast aluminum engine block, and a new name. They're Rambler



LOWER HOOD and new grille, fenders, and trim give bigger Rambler—the Classic—a new look. Company president Romney says Classic will change, but only slightly, year to year. American will retain its styling, he promises, for indefinite period.

**There's a
four-door
wagon, too**

New Rambler American wagon seats six, or can tote 64 cubic feet of cargo. It weighs 2,700 lb., comes with either a 90-hp. or 127-hp. cast-iron-six power plant.



Here's the smallest U. S. convertible

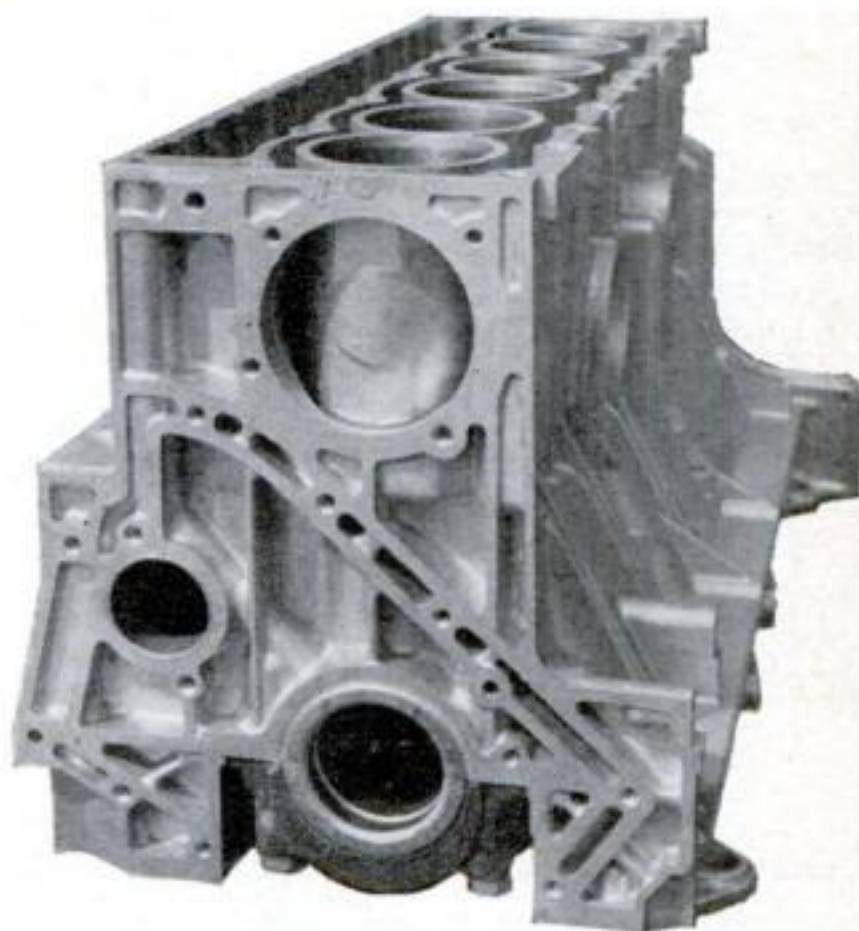
This sporty American, only 173 inches long, will be the smallest—and lowest-priced—U. S. convertible when it bows in December.

Classics now, be they sixes or V-8s. (Former names: Rambler Six and Rambler Rebel V-8.)

The simple, latticework aluminum grille snugles between lowered dual headlamps. Fenders and hood are new.

The aluminum engine has the same displacement, bore, and stroke as the cast-iron six it replaces; using the same tools to machine it saves money. Cast-iron liners fit in each cylinder, and a cast-iron head tops the block.—*Ken Fermoye.*

BIG RAMBLER comes, as before, with two engine options, a six or a V-8. An aluminum block (right) makes the six-cylinder job 80 pounds lighter than its cast-iron predecessor.

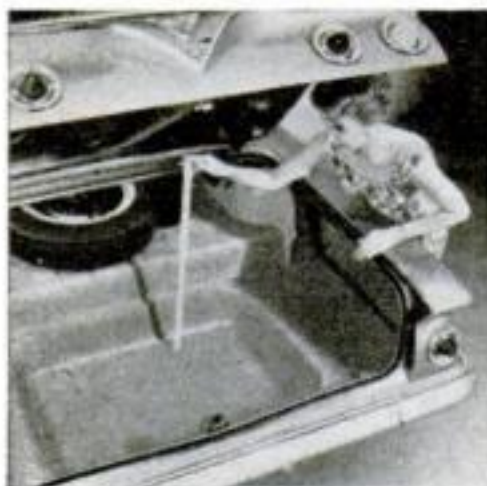


RAMBLER CLASSIC wagons, like all '61 Ramblers, have ceramic, rustproof exhaust systems, guaranteed to original buyer as long as he owns the car. Side-hinged tailgate, introduced on three-seat wagons last year, is now offered on two-seaters.



Big Cars Aren't So Big Now

Chevrolet



DETROIT's trend to the ever-longer has been reversed for 1961. Four of the six "big" cars you see on these two pages have been bobtailed. Two are narrower.

Designers narrowed the Chevy's body (above) by $2\frac{1}{2}$ inches, shortened it $11\frac{1}{2}$. A bigger trunk boosts space by a third; it takes bags standing up.

Oldsmobile



A SMALLER, restyled Oldsmobile body rides on a new frame. Its splayed-out sides permit lower floors. A slimmer Hydra-Matic transmission cuts drive-tun-

nel height by a fourth. Seating comfort is increased by higher benches, and that knee-knocking dogleg is gone from front pillars. Hardtops have more head room.

Ambassador



THE biggest Ramblers, the Ambassador models, look less like their little brothers. The driver can lock all four doors at the flick of a dash-mounted switch—by vac-

uum power. New front shocks have built-in rebound control to prevent bottoming on rough roads. Ceiling panels are made of molded fiber-glass.

...and One Even Costs Less

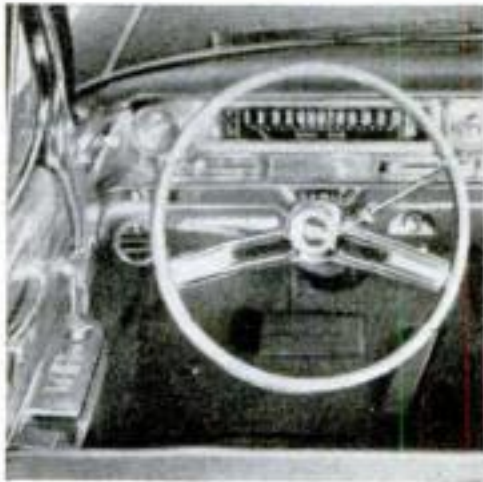
Chrysler



SLANT-EYED headlights flank the Chrysler's new grille—which looks like last year's turned upside down. There is a new, less costly series called the New-

port. Newports use a smaller engine—361 cu. in.—than other Chryslers, and they run on nonpremium gas. Manual-shift transmission is standard.

Cadillac



STYLISTS clipped Cadillac's big tail fins a bit. Body lines are crisper and less rounded. The cars are three inches shorter than '60s, but they've got more

head room and leg room. Wider doors make getting in and out easier. Rubber and plastic bushings and sealed-in lubricants eliminate chassis greasing.

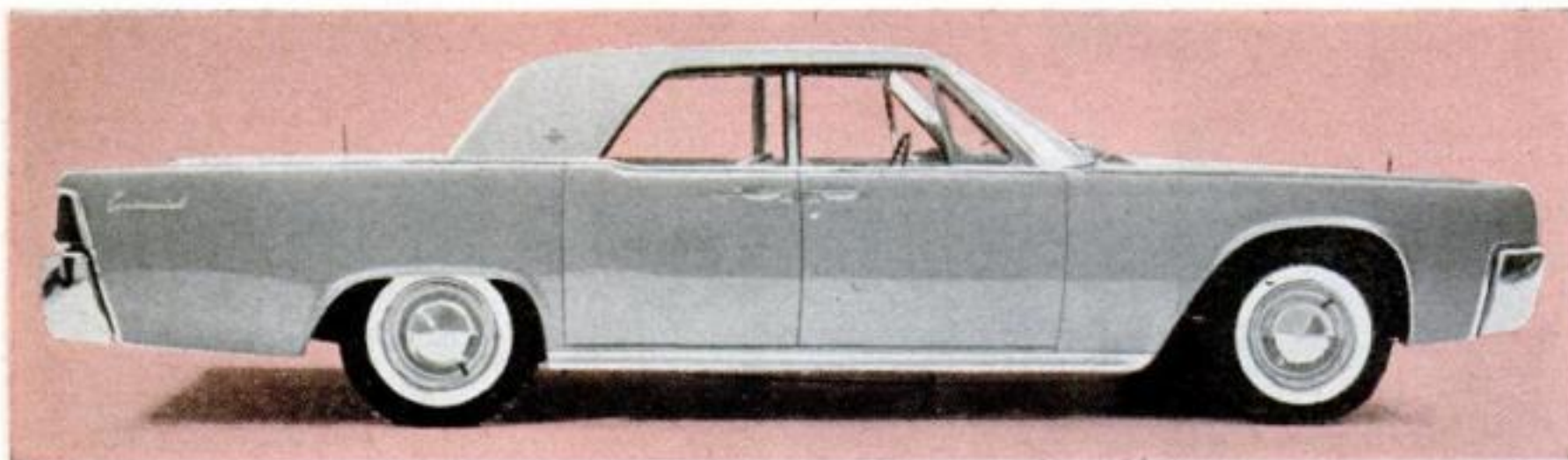
Mercury



MERCURY is 4½ inches shorter, a fraction narrower. On Ford's basic body shell—well disguised—it has a stretched version of the Ford chassis. There's a touch

of T-Bird in the roof line, a bit of Lincoln aft. A new suspension system lets the wheels move rearward as well as upward to absorb road shocks.

Even the Lincoln is shrinkin'



THE automobile called simply the Lincoln is no more. There are only Lincoln Continentals, and but two of those—a four-door sedan and a four-door convertible. They're 15 inches shorter and 400 pounds lighter than '60 models. They need little care—oil changes each 6,000 miles, greasing each two years. You never change the fluid in the new, smaller automatic gearbox—there isn't even a drain plug. Engines are run-in three hours, then torn down for inspection. Every car is road-tested.



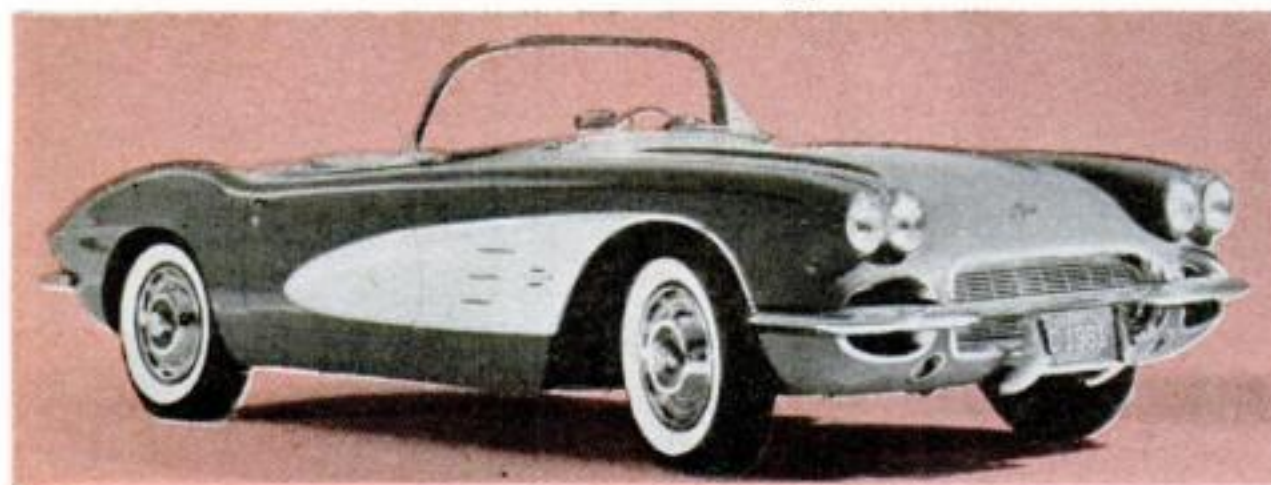
T-Bird steering wheel swings aside



THE engineering doodlers at Ford have revived an idea some 35 years old—a swing-away steering wheel for easier entry for the driver. This one pivots to the

side. The rear-view mirror is glued to the windshield instead of projecting on a pedestal. A new body (frameless) is made in two sections and welded at the cowl.

Corvette is reshaped fore and aft



CHEVY designers have tinkered with Corvette, front and back. The grille is higher and wider. Bumpers are sturdier to better protect the fiber-glass body. The

deck lid in the restyled rump is bigger. That provides more room in the trunk. Sports-car buffs will find the car a half-inch longer and 2½ inches narrower.

Ever Hear of a 'Trucklet'?

This one has its engine in back



Take a vest-pocket engine and a short wheelbase, add a pygmy-size truck body, and you've got something new in U. S. automotive vehicles—a trucklet.

Two trucklets, one by Chevrolet (above) and one by Ford (below) rolled into view last month. Like the minibuses (page 82), they use parts from each corporation's compact cars, the Chevy Corvair and the Ford Falcon. The Chevy is a side-loader with a ramp. It hauls a payload of almost a ton without heavy-duty springs or bigger tires.

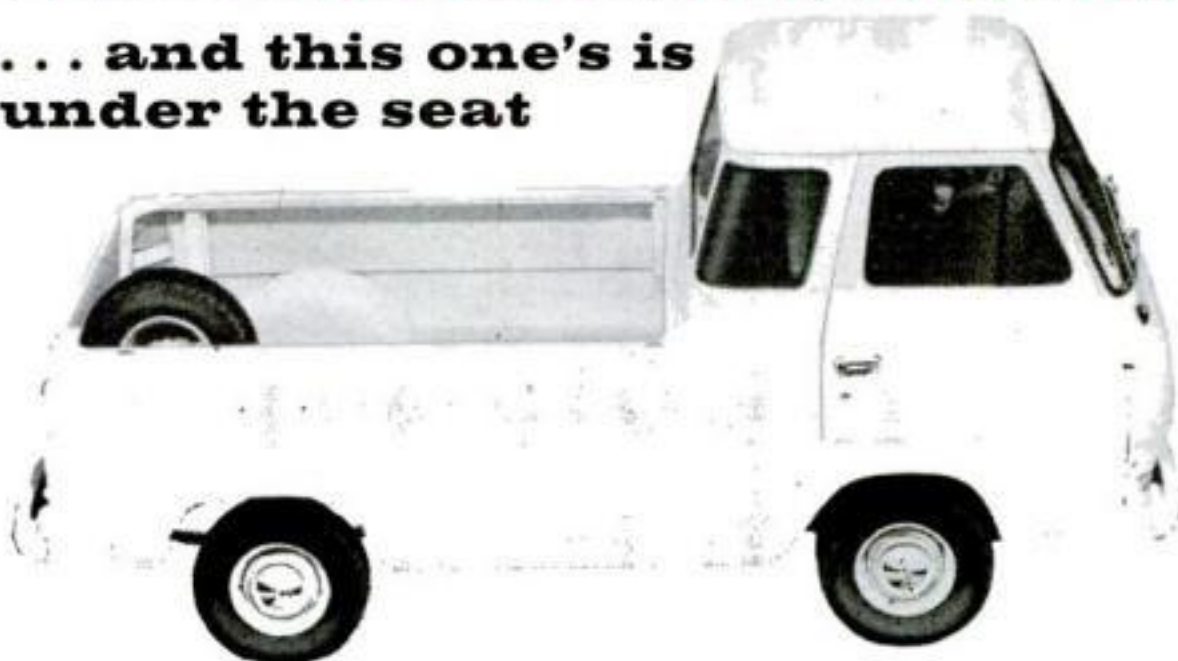
Most of that load is toted in a drop-center deck, resulting in unusual road stability.



DROP SIDES take work out of loading—just roll cargo up ramp. There's a regular tailgate, too. Battery fits over left-rear wheel housing. Opening a hatch exposes it.



... and this one's is under the seat

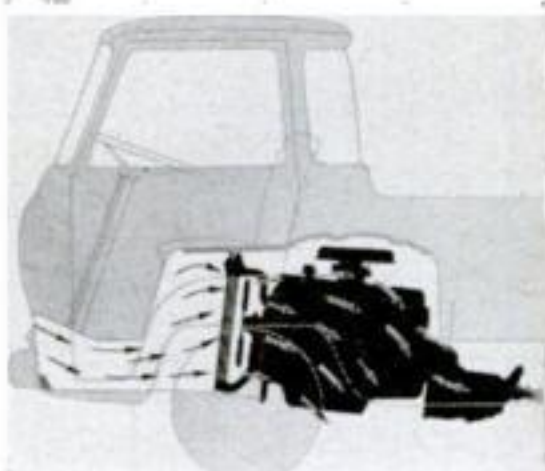


Ford's trucklet carries a seven-foot-long cargo box on a 90-inch wheelbase. The whole vehicle is only 14 feet long (a foot shorter than the Chevy). Stiffer springs and bigger tires—offered as options—boost its maximum capacity to 1,700 pounds.

The position of the Falcon engine (right) gives the Ford a drive shaft less than 30 inches long. Result: no power-train vibration. The Ford's body, like the Chevy's, is unitized—no separate frame. At the tailgate, the cargo deck is a bit more than 25 inches from the ground—an inch less than for the Chevrolet. The cab holds two—a driver and one rider.



FRONT VIEW shows Ford even more snub-nosed than rear-engine Chevy; its beneath-the-cab engine thrusts up between the two single seats.





1. FOLDED INTO A COMPACT BOX, this trailer house rides easily on wheels behind a car for on-highway travel.

Folding house opens like a book

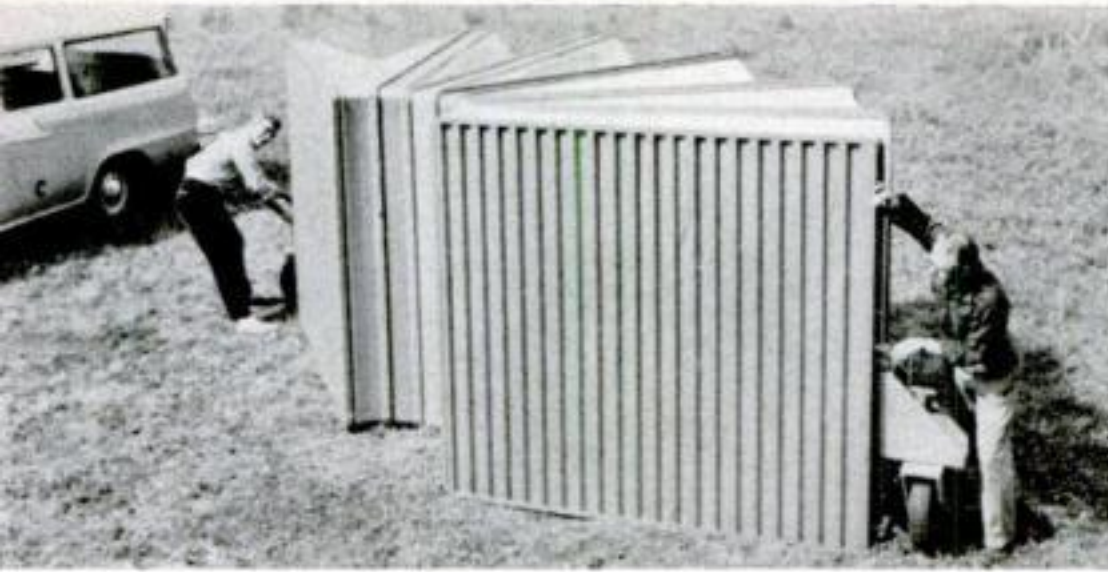
This camp house squeezes together like an accordion to make a box-shaped trailer for on-the-road travel, opens into sleep-

ing quarters for six and a roofed outdoor living room. Seven aluminum-channel ribs, held together by laminated vinyl and nylon, form six wedge-shaped bunks when the two sides are rolled out at right angles. Screens can be attached to both



Racking up more bombs

Equipped with a bomb-rack adaptor, the Navy's midget A4D Skyhawk attack bomber carries a load of 18 bombs instead of its normal three. Developed by Naval Ordnance, the multiple carriage has been flight-tested from the carrier Independence. Douglas is the builder.



2. IT OPENS LIKE AN ACCORDION: Sides are fanned out forward until they are in line.



3. ROOF IS FORMED by hinged sides that raise to expose table, benches, and cupboards.



4. PIE-WEDGE BUNKS sleep six, can be partitioned off by screens for individual privacy.

sides of each six-inch-wide rib for sleeping privacy and for storing bedding in transit.

The two aluminum end panels are hinged and lift to form a patio roof. Nestled behind them are a center door-

way to the sleeping quarters and, at either side, a folding table and benches, and cupboards for utensils, groceries, and other camping needs. The trailer, designed for the Aluminum Co. of America, was introduced at an Indianapolis show.

Wheeling in triplicate

The birth of triplets demanded some ingenuity by Calvin Bublin of Point Lookout, N. Y.

When the three boys were ready for airing, he joined three carriages by passing a rod through loops at the rear. Now his wife can wheel all at once.

A "rumble seat" on the center buggy makes room for a two-year old sister.





Popular Science observers watch SAC show how, in case of sudden attack, it could direct a counterblow from a—

War Room in the Sky

By Frank Harvey, with photos by W. W. Morris

OUR orbit pattern was secret. All I'm allowed to tell you is that we were flying at 500 m.p.h. at 35,000 feet, and we were staying at all times within radar range of Offutt Air Force Base, near Omaha. The reason for this was grim: If the Russians placed an ICBM with a nuclear warhead squarely on the key nerve center of the Strategic Air Command, the huge underground control room at Offutt, we would see the explosion on radar—very pos-

Seven miles above Nebraska, Gen. James E. Wilson (center, facing camera) and security-guarded staff talk with Guam in a test of flying command post.



An "alert" crew at left races to man one of converted jet tankers always prepared at Offutt AFB, near Omaha, to become SAC's headquarters aloft. This crew must keep within three minutes' dash of the cockpit.



"Control team" of experts climbs into plane with all data needed to direct massive U. S. retaliation in case ground command were destroyed.

One of 10 generals constantly ready to take charge of the war room in the sky in a crisis, General Wilson swings aboard for a practice session.



SAC's aerial nerve center relies on superb radio equipment



Through this switchboard, communications experts can reach any AF unit or plane in the world. They try all available channels and pick the best before delivering the connection to officers seated at the plane's "command table." Trouble shooters stand by to keep the elaborate radio gear always functioning at its peak efficiency.

sibly would see the monster flash itself.

Our plane was a modified KC-135 jet tanker. It could stay aloft for 20 hours, if the pilot nursed his fuel. Instead of extra tanks, it was packed with sophisticated single-side-band radio powerful enough to talk with every SAC base and every airborne bomber or tanker in the world. It was staffed by a "controller team" of officers trained in the underground war room back at Omaha. Its radio gear was monitored, maintained, and operated by sergeants whose specialty it was.

I was riding along, with PS photographer Bill Morris, to watch SAC's latest trick for countering a sudden missile thrust at the U. S. A.

The setup worked this way: The sergeants sat in front of the operation panel, much like switchboard operators at a big-city exchange. They established the best possible communication between the plane and its communication target, plane or ground station, often trying three or four channels to obtain the one that gave the clearest reception. Having achieved top clarity, these operators turned over the circuit to a team of four officers seated at an adjoining table. These officers then conducted whatever exercise problem they wished. They spoke either in phonetic code or in normal words (scrambled before transmission

and unscrambled at the point of reception).

The "SAC look." Boss of the entire operation was a young major general, James E. Wilson, Director of Matériel for the Strategic Air Command, one of 10 generals who regularly fly this back-up mission for ground-control stations. General Wilson, one of the elite officers in the Air Force, had the "SAC look": grim, alert, and very businesslike. If a surprise missile attack wiped out all SAC ground-control stations, General Wilson would suddenly become the most potent American alive. He would be in personal control of the entire strike power of SAC. Upon his decisions would rest the conduct of massive retaliation against the aggressor.

How would he do this?

Let us assume the worst: A sudden blaze of white fire sears through the cockpit windows and seconds later a telltale mushroom cloud towers in the sky above Offutt AFB. General Wilson does nothing at this point. He waits for his Chief Controller, Colonel Leo Lewis, to make the first grim checks.

"Hello, Head Shed," Colonel Lewis says, speaking into his lip mike directly across the small command table in the KC-135. "This is Private Eye. Do you read me? Over."

From the underground control center

and sure power

Known as APU in the Air Force, an auxiliary power unit is mounted in the rear of all KC-135 jet tankers. It runs on fuel from the plane's giant tanks.

In case it became necessary for SAC's flying command post to land at a remote airstrip, the APU could keep those vital long-range radios working and provide heat, power, and light for living on the ground.



at Offutt, there is nothing but a tragic, telltale silence. Lewis quickly repeats, gets no answer, and moves on to the next step. He announces, without further delay, the observed nuclear blast at Omaha. He uses a special channel that is being monitored by every control facility and every airborne plane in SAC. In a matter of seconds, the Strategic Air Command, world wide, thus knows that Offutt AFB, either accidentally or by design, has been blown off the face of the earth.

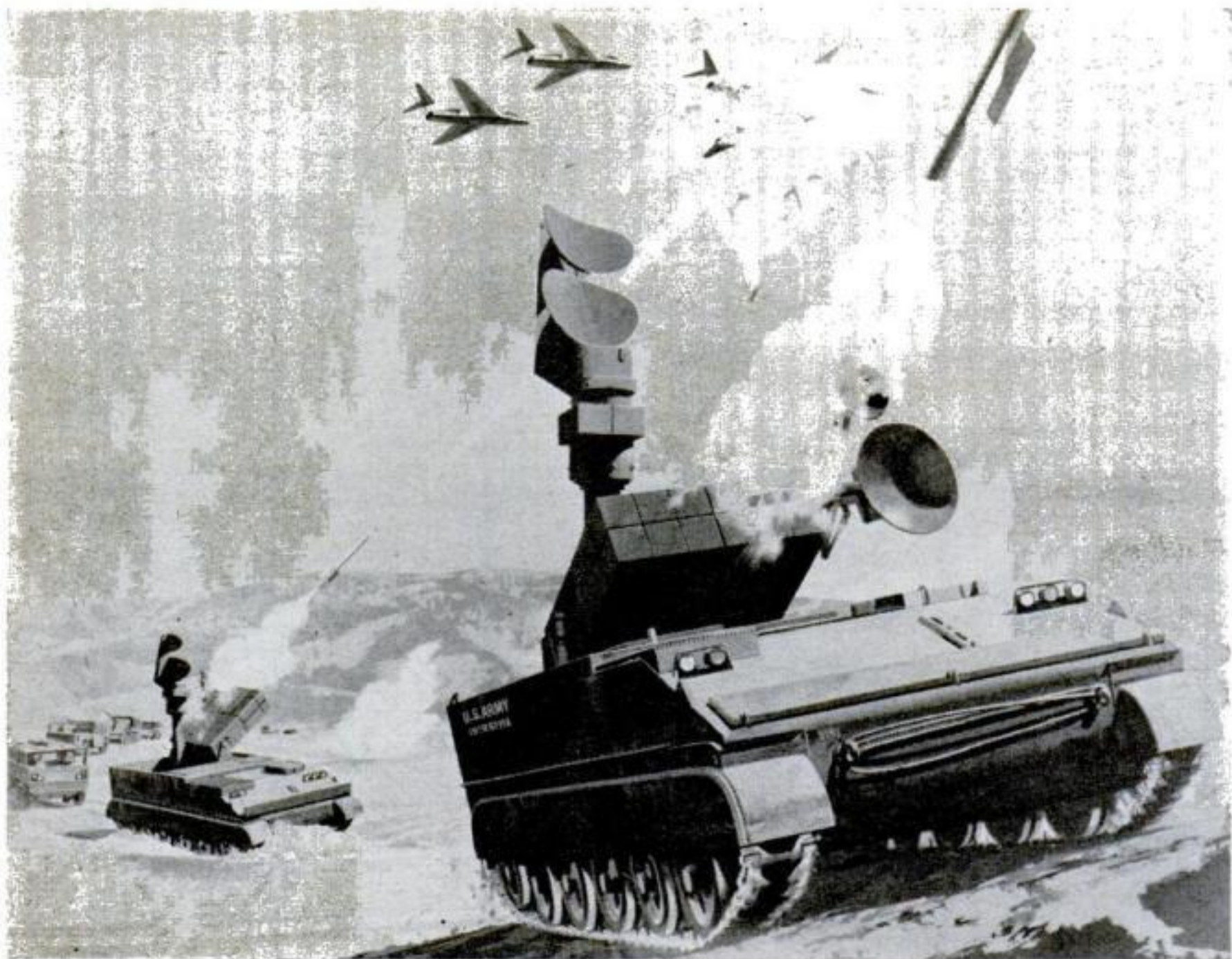
Taking charge. There are, of course, a number of alternate ground-control centers in addition to the master control at Offutt. These centers pick up the transmission from our tanker. If any one of them is still intact and able to function, it then immediately notifies General Wilson that it is assuming control—and he goes off the air. But he stays up there listening, in case a missile should wipe out this last station. If the latter happens, or if General Wilson gets no response from any ground-control centers, he at once takes charge of the situation. Over the radio he says something like this: "Hello, Potomac. Hello, Potomac. This is Private Eye. Come in, please!"

Meanwhile, all over the world, the ready crews of SAC bombers and tankers are racing to their planes in a desperate attempt to get off the ground before additional missiles can find them. A num-

ber of planes are on 15-minute alert. These get off first. The rest follow as soon as possible. Our missile crews at Vandenberg AFB, in California, and Francis Warren AFB, in Wyoming, ready their ICBMs and stand by for launch orders.

Silence at Potomac. But no word comes from Potomac—the war room buried deep under the Pentagon in Washington, D. C. General Wilson's reason for calling "Potomac" is to establish direct contact, by means of special "radio patching," with the President of the United States, whose word is necessary to loose an armed counterattack. The reason for Potomac's silence is sinister: A sudden shower of atomic missiles, launched by enemy submarines lying offshore, has practically wiped out Washington. But now the matter of getting a go-ahead from the President has become academic. Reports coming to the airborne control center establish beyond a doubt that this is truly a massive attack against the U. S. Submarine missiles strike key bases: Vandenberg and Castle, in California; Westover, in Massachusetts; Guam; Clark, in the Philippines; and Okinawa. Enemy ICBMs fall on New York, Chicago, San Francisco, and other cities. General Wilson has no alternative; he must assume control of

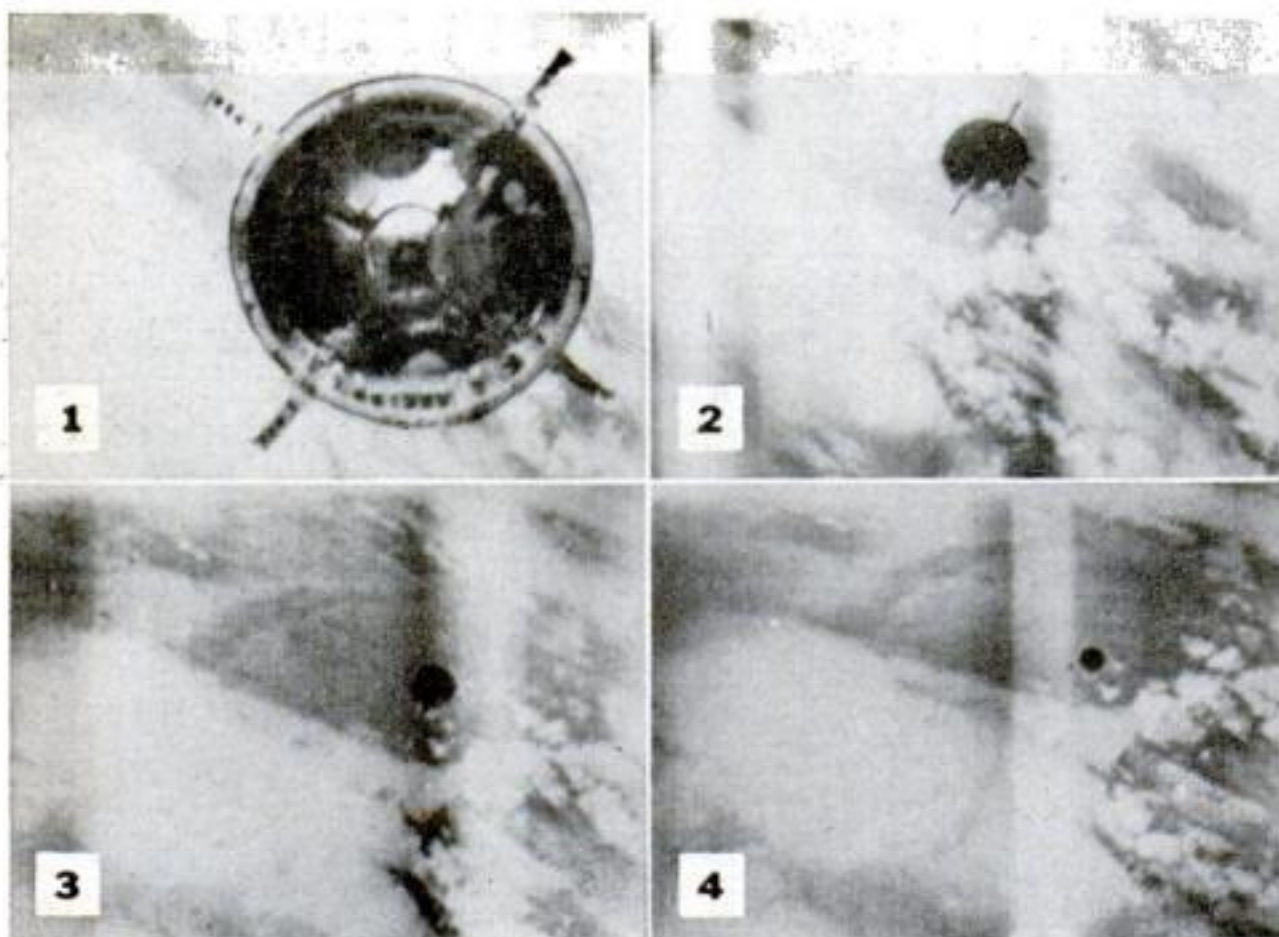
[Continued on page 218]



Mobile sky sweeper

Here's the Army's newest battlefield defense against short-range missiles and jet attack planes. The Mauler is an automatic-firing system atop an amphibious tank. It will be able to track multiple

targets and launch missiles from any position, parked or on the run. The unit will carry its own radar, fire-control equipment, and power supply. Designed by Convair, it will be stabilized gyroscopically for shooting on the move while one man operates it.



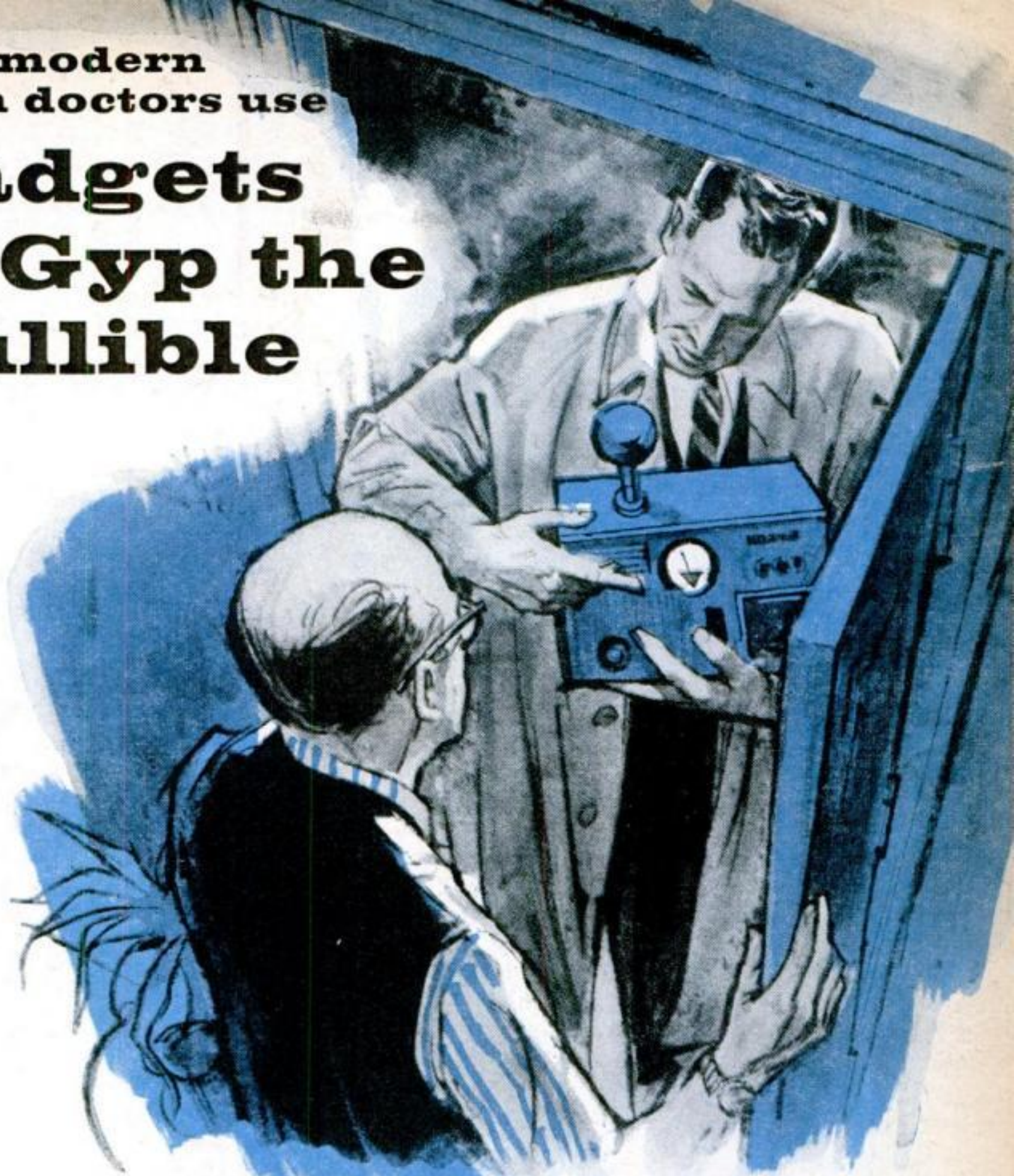
TV follows missile to target

Missilemen now look at television to see their rockets smash into the target. A small camera package, ejected backwards from the nose at 40-mile altitude, follows the warhead all the way down, transmitting pictures to a monitor in the blockhouse.

These four views, taken over 20 seconds, show a Redstone whooshing toward the Rio Grande.

**How modern
witch doctors use**

Gadgets to Gyp the Gullible



**Worthless devices that blink, buzz, heat up, or give shocks
are sold to Americans as "cure-alls" for \$500,000,000 a year**

By Wesley S. Griswold

LONG ago, an exasperated writer noted that ordinarily shrewd Americans often become soft in the head when given a chance to buy dubious contraptions reputed to be good for what ails them.

Last year, Americans are reported to have thrown away at least \$500,000,000 on phony remedies and an array of weird and worthless "medical" gadgets

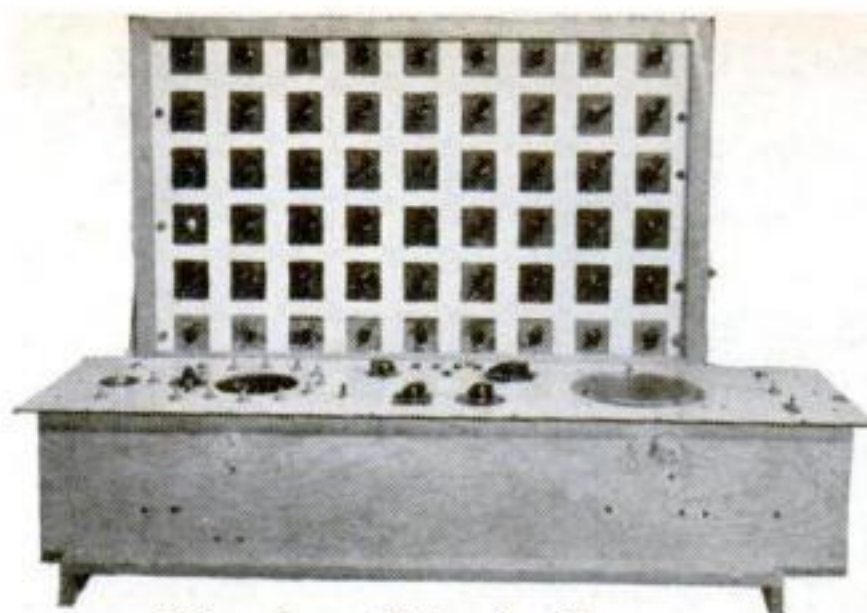
The Pathoclast looks like an ancient radio, but isn't that useful. It was touted as able to diagnose and cure any ill.



CONTINUED

99

Scientific-sounding names and an aura of mystery



There's nothing in the \$545 Radionic Machine (above) but lots of rheostats and switches. It was said to be able to treat diseases.

The ridiculous Atomotrone (left) sold for \$300. It "irradiated" food and water with colored light and signals from a tiny radio transmitter on the top shelf.



With a price tag of \$75, the Uranium Ray Pad sold as a cure for arthritis. All it had in it was crushed rock, a bit radioactive but not a bit beneficial.

that they should have regarded with hoots of laughter.

Ailing and aged members of both sexes are sadly gullible when fast talkers tell them that they may be healed by devices that glow, blink, buzz, ring, heat up, produce shocks, or merely look terribly complicated.

As the Medical Society of the City of New York has regretfully noted, lots of folks have a weakness for "secret and mysterious agents" to treat their ills.

Consider, for instance, that in California the other day investigators for the Public Health Dept. found a modern witch doctor administering to cancer patients by letting them feel the vibrations from a tape recording of "Smoke Gets In Your Eyes."

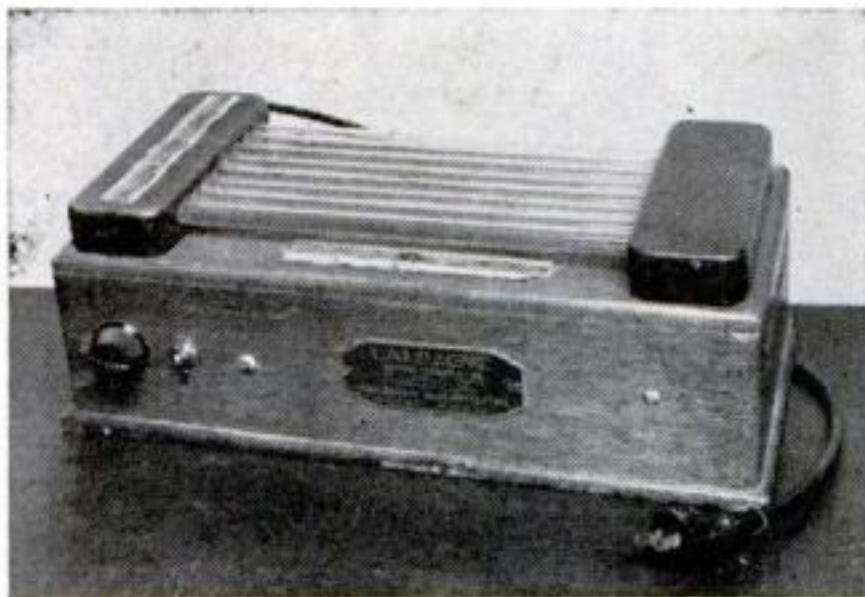
California's Food and Drug inspectors recently caught up with a man peddling an Electronically Active Steel Ball. It was only a ball bearing, but the pitch was that it had been energized with 81,000 volts of electricity. Any person gullible enough to buy one was assured that the ball had since been grounded, so it was harmless. Nevertheless, it was said to retain the ability to "cure pain permanently" if one only rolled the little steel marble around over the area that ached.

Naming the baby. Quacks have always tried to lend their mechanical fakes an air of mystery and respectability by giving them names with an up-to-date scientific sound. The words "magnetic," "galvanic," and "electric" were used to tag a museum load of ridiculous apparatus during the eighteenth and nineteenth centuries.

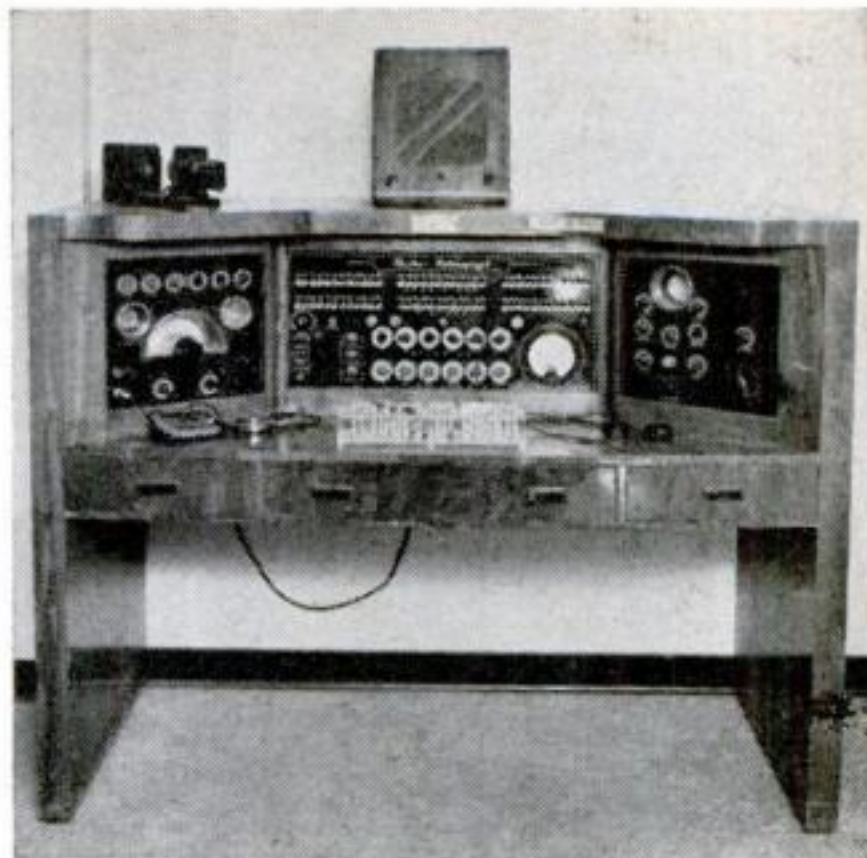
Oxygen for a while was the darling of the humbugs, who devised a multitude of fake instruments for propelling it into people's blood streams. Nowadays, ozone is having its fling. Though ozone is known to science as being harmful to humans in concentrations greater than one part in a

helped make suckers out of people who bought these

The Electro-Metabograph (right) was alleged to be able to pick the proper drug for a cure from the rack in front of it. Behind the panel was nothing but rotary switches.



Mice were killed by gas from this ozone generator (above), which cost \$150 and was claimed to help benefit 47 human ailments.



The Radon Bell held a trace of radium and iron oxide. It was supposed to convert tap water into a cancer cure and stop falling hair.



million parts of air, quacks tout it as "God's Gift to Humanity."

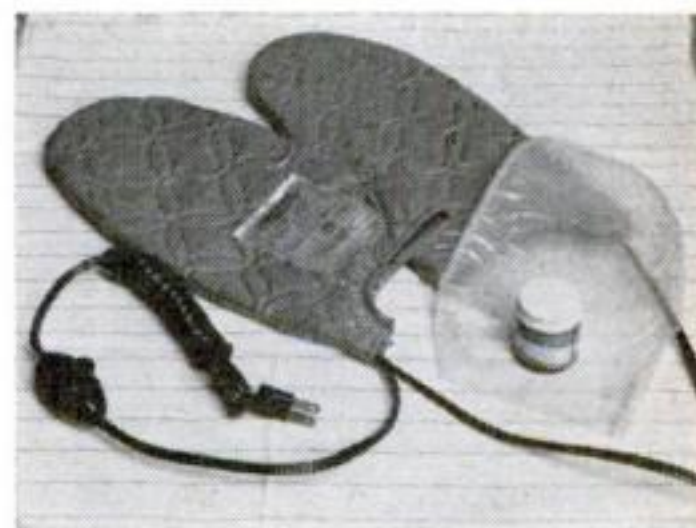
There has been a spate of Ozone Generators in recent years. One of them, the Calozone, seized out West, generated enough ozone to kill mice. Yet it was recommended by its salesmen as being helpful in treating 47 human diseases.

After the Curies discovered radium, quacks hurried to apply that word and variations of it to a new batch of gimcracks that they guaranteed would soon have everyone glowing with health. These charlatans have also drawn freely for names and ideas on the fields of chemistry, radio, and, lately, nuclear physics.

Consider the Atomotrone. Seized not long ago by U. S. Food and Drug Adm. operatives, it sold for several hundred dollars but was produced for a small fraction of that. And it was worth nothing.

Basically, the Atomotrone was a small white metal cabinet that stood on the floor. Inside, at the top, hung a photoflood lamp. On the single shelf beneath it rested two trays of glass slides of various colors. Square holes had been cut in the shelf under the trays. Beneath these were two compartments in which to place food and water. The salesman's spiel promised that edibles "irradiated" by the light shining through the colored glass would become possessed with marvelous healing powers.

But the maker of the Atomotrone had been unable to resist a fancy touch that led to his downfall. On the top shelf, presumably to make the irradiation richer, he had installed a tiny short-wave transmitter, which broadcast a steady but very weak signal. The signal wasn't quite weak enough.

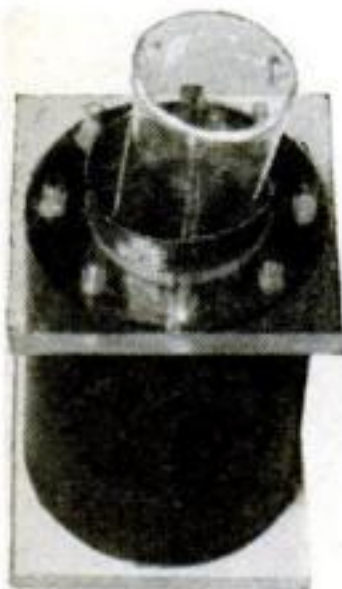


These so-called Therapeutic Mittens, though said to help cure arthritis, did nothing more than heat the hands.

Residents of San Bernardino, Calif., soon began to complain of mysterious interferences in their radio and television programs. The FCC sent out a truck full of gear to get a fix on the source of the trouble. The truck homed on a local Atomotrone, busily irradiating some tidbits. The Food and Drug people carried on from there.



A \$30 bag of dirt, the Rado Pad was supposed to contain uranium ore and be valuable in treating arthritis.



This device for irradiating blood did nothing for the patient but did endanger operator.



Renovated electric blankets have been sold to arthritics as "quick cures." Many caught fire.

Another gizmo they stumbled upon recently was a large bullet-shaped case with a brown plastic nose. It was mounted on an elaborate carriage and could be swiveled.

What was this for? Well, the barker said that disease is caused when molecules in the body's cells get out of alignment. This Molecular Normalizer would pull 'em back where they belonged.

Poking curiously inside the casing of the Normalizer, Public Health Dept. sleuths found a small electromagnet in the nose. It pulsed when a switch was flipped. At the same time, an ordinary light bulb at the rear of the casing flashed rhythmically.

Fascinating, but foolish—except to trusting innocents, who usually could ill afford to be hoodwinked.

Quacks have embraced the hardware and language of electronics with all the enthusiasm of a tribal medicine man receiving a new shipment of rattles and amulets.

When radio was still young, there broke out a rash of mechanical fakes that were supposed to be able to "tune in" on body ailments, diagnose them, and cure them.

Most of these devices resembled radio transmitters, their panels loaded with dials, rheostats, little light bulbs, meters, and switches.

The theory was—and is, for gadgets of this type stubbornly persist—that every organ of the human body has a vibration all its own. When pain strikes, the vibratory rate mounts up—or at least changes.

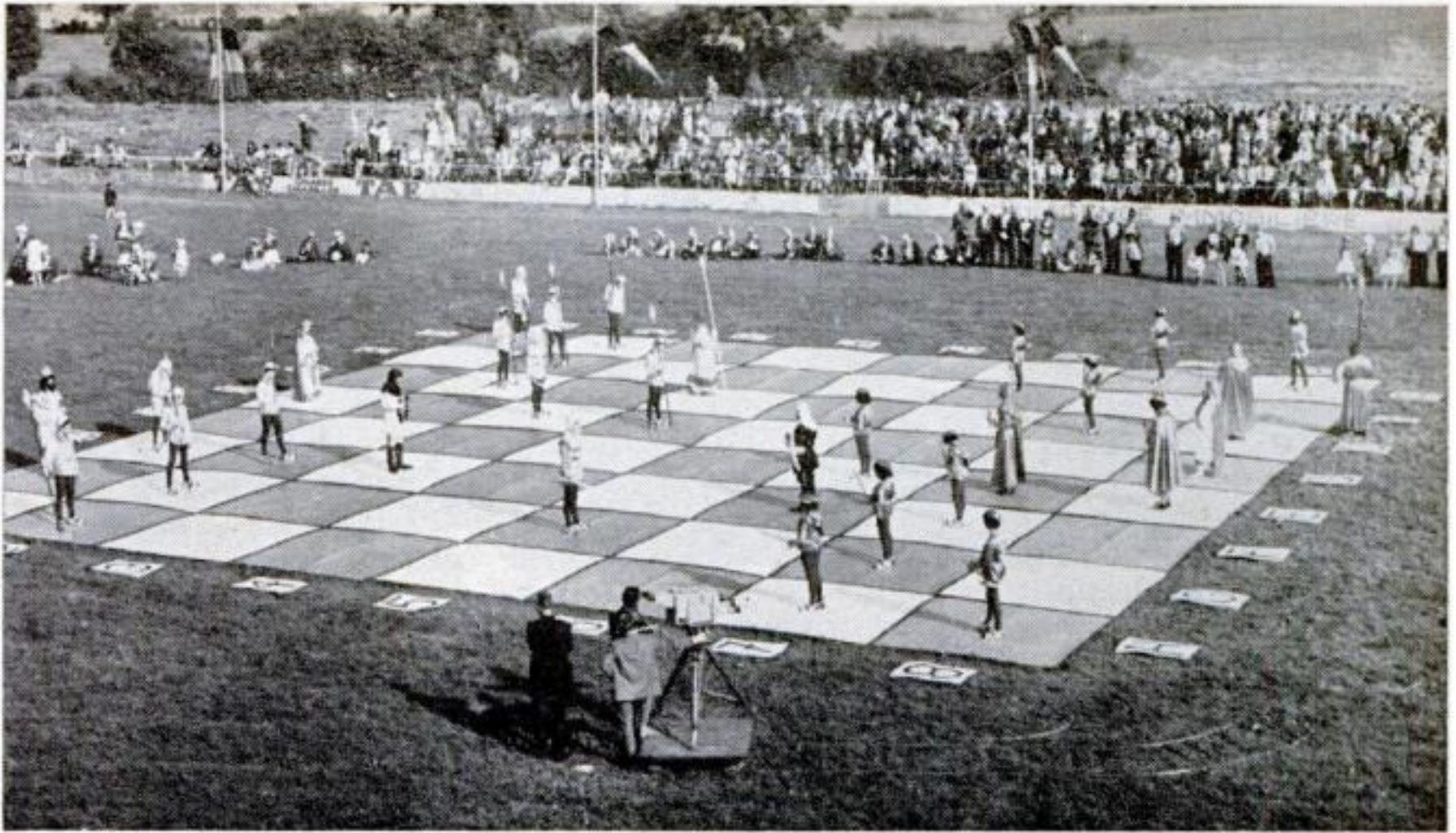
The operator of one of these absurd machines is presumed to be able to track down the organ with the sour vibration and tell its owner what's wrong with him.

Devices of this type seized in late years by Food and Drug inspectors, both federal and state, have had such alluringly mysterious names as Radionic Machine, Electro-Metabograph, and Pathoclast.

Lighting up for diagnosis. A typical "diagnostic machine" plugs in like a floor lamp and has little behind its impressive panel but rows of rotary switches, wired in series. There's usually a flasher to make the lights on the panel blink whenever desired, and a transformer to reduce the house current for the blinker. Often a buzzer or an electric bell is wired into the apparatus to provide stimulating sound effects. And that's all.

The operator sets the dials in any manner that suits him, and he's ready for business. Out in front of the panel, on the desk or table top, rests a small circle of fiberboard with a resistance coil under it. This little "hot plate" is as essential to the operator's performance as a wand is to a magician's.

[Continued on page 222]



Human side of chess

Living chessmen, in medieval costumes, carry out the moves in a colorful match played on a giant board at the Eupen, Belgium, soccer stadium. Moves were

called out by two chess champions, O'Kelly de Galway of Belgium and Georg Kieninger of Germany. The "pieces" advanced, retreated, and were captured as an enthusiastic crowd watched over an hour until Kieninger was checkmated.



SET FOR RECORD, Ross moves to starting line. At top speed, entire hull rides out of water with lower half of propeller below water line.

World's fastest outboard

A new international speed record of 115.547 m.p.h. has been set for outboards by Burt Ross Jr. of Spokane, Wash. It was the average top speed of two runs



SHOWER BATH drenches two of Ross's aides as a third, standing on dock, starts the six-cylinder outboard engine with a compressed-air drill.

over a one-kilometer course on Lake Washington in Seattle. Ross drove a streamlined three-point hull built by Ted Jones, designer of Gold Cup speedboats. It was powered by a 60-cu.-in. six-cylinder Mercury Mark 75H engine.



VIEW THROUGH WINDSHIELD of car for driving schools is a realistic street-scene shadowgraph that moves on a screen.



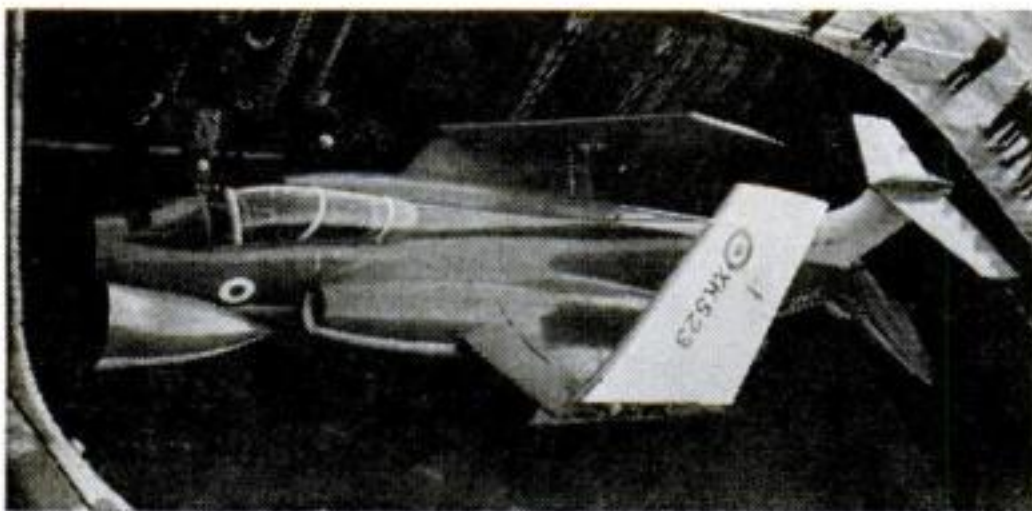
CAR ON RAMP has front wheels mounted on swivels so learner can practice making turns.

Learning to drive with moving shadows

A realistic shadowgraph is projected on a screen seen through the windshield of this British basic-driving trainer. Pro-

jection equipment consists of a landscape model on a revolving plastic disk—complete with road signs, curbing, telegraph poles, and trees—and a stationary light source placed at eye level.

Rotation of the disk is regulated by



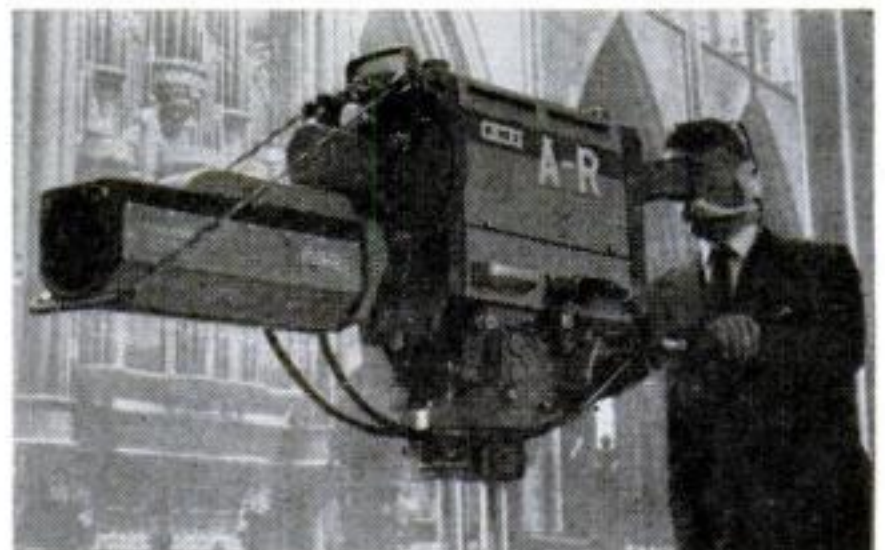
Nose folds on hinges

Nose and wings that fold back with hinges fit this new twin-jet Blackburn NA-39 into its under-deck hangar. Now undergoing sea trials, the carrierborne strike plane is designed for high speed at low levels so it can deliver a nuclear bomb unseen by enemy radar. The British call it their Navy's deadliest weapon.



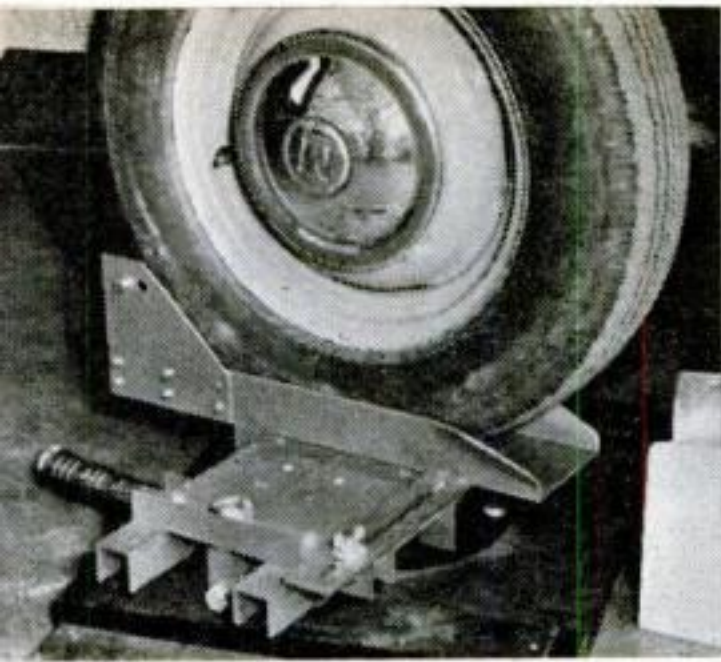
Appetizing auto

The 1938 Ford coupe above is decorated with beans, peppers, and other vegetables stuck on with adhesive. The souping-up job was done by Julius Johnson, young Hollywood actor. It took him six weeks, and he wouldn't do it again for \$1,000. The car has one disadvantage: When it rains, Johnson stays home.



Giant zoom lens

The big zoom lens on this TV camera has a focal length variable from 4 to 40 inches that makes possible a gradual shift from extreme close-ups to long-range shots. The lens, made in Britain, contains 13 separate glass elements. It's 27 inches long, weighs 33 pounds, and is housed in a precision-built casing.



CLOSE-UP OF SWIVEL UNIT shows how it turns with wheels to give driver the feel of the road.



LAMP ON EXTENSION ARM casts moving shadows on the screen as the plastic landscape revolves on a motorized turntable.

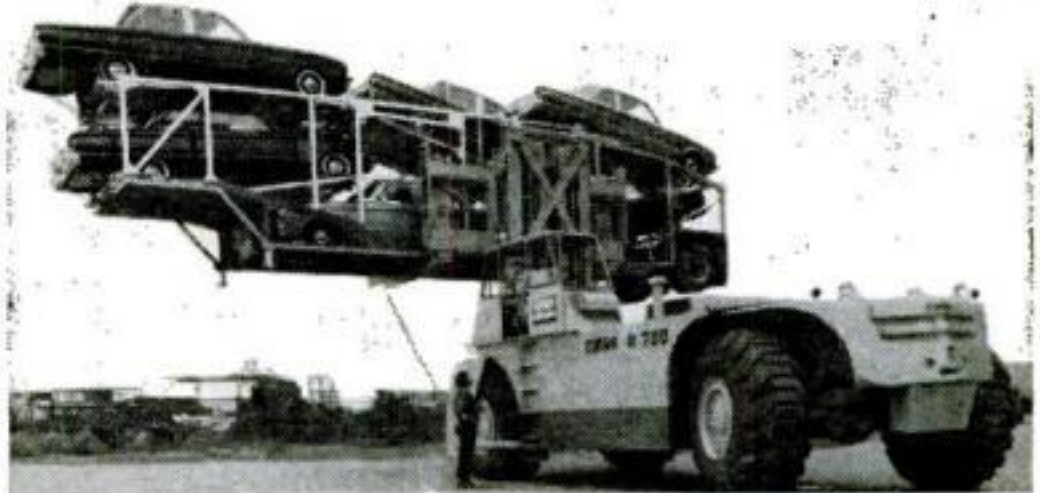
a turntable electric motor controlled by the car's accelerator and brake to simulate apparent road speed. Front wheels are supported on swiveling brackets that transmit steering action. Movement of the clutch is indicated by a signal light

on a control panel held by the instructor. The Sim-L-Car is intended for the first few hours of lessons, permitting learners to overcome nervousness and unfamiliarity with the car and its controls without being distracted by actual traffic.



Riding on a beam

Maintenance men on the 153-mile Friant-Kern Canal in California inspect the banks in style for erosion, rodents, and weeds. They ride on the end of a 12-foot beam hanging over the side from the rear of a truck. It's on a swivel mount so it can swing out of the way when they go through gates. Riding speeds up the job and keeps the men out of reach of rattlesnakes.



Biggest lift in the world

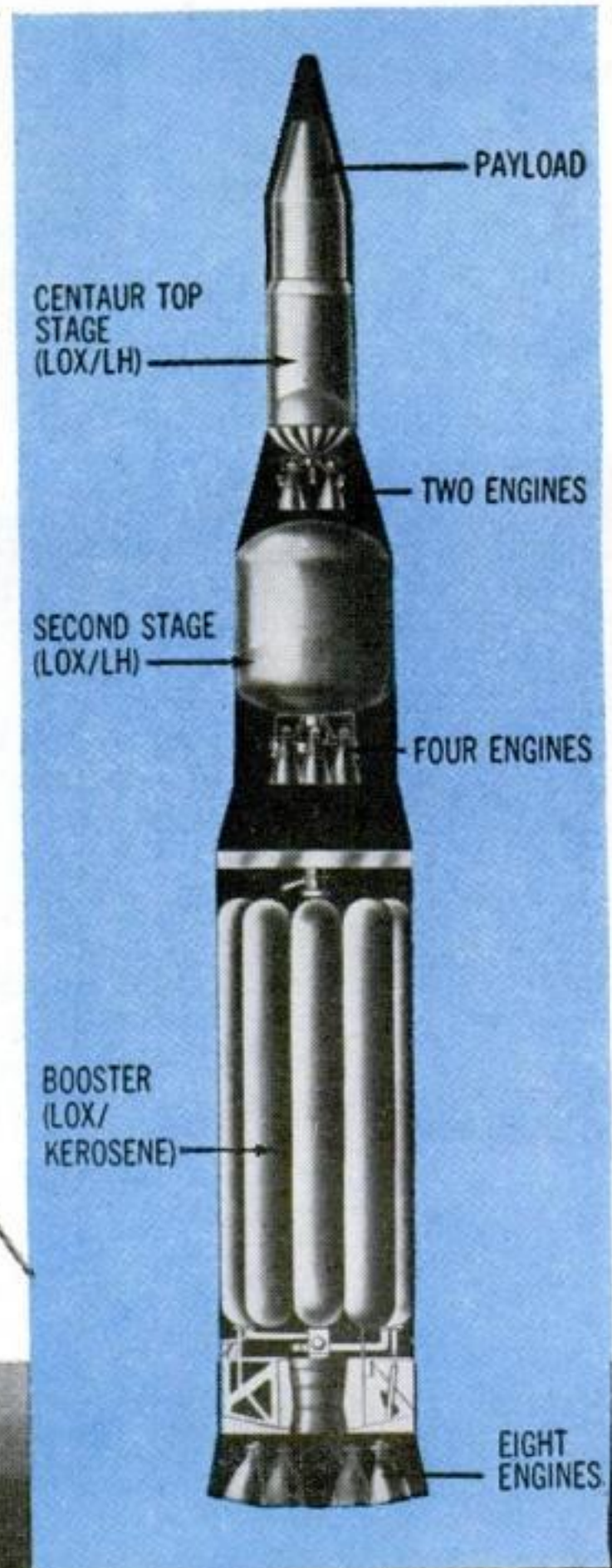
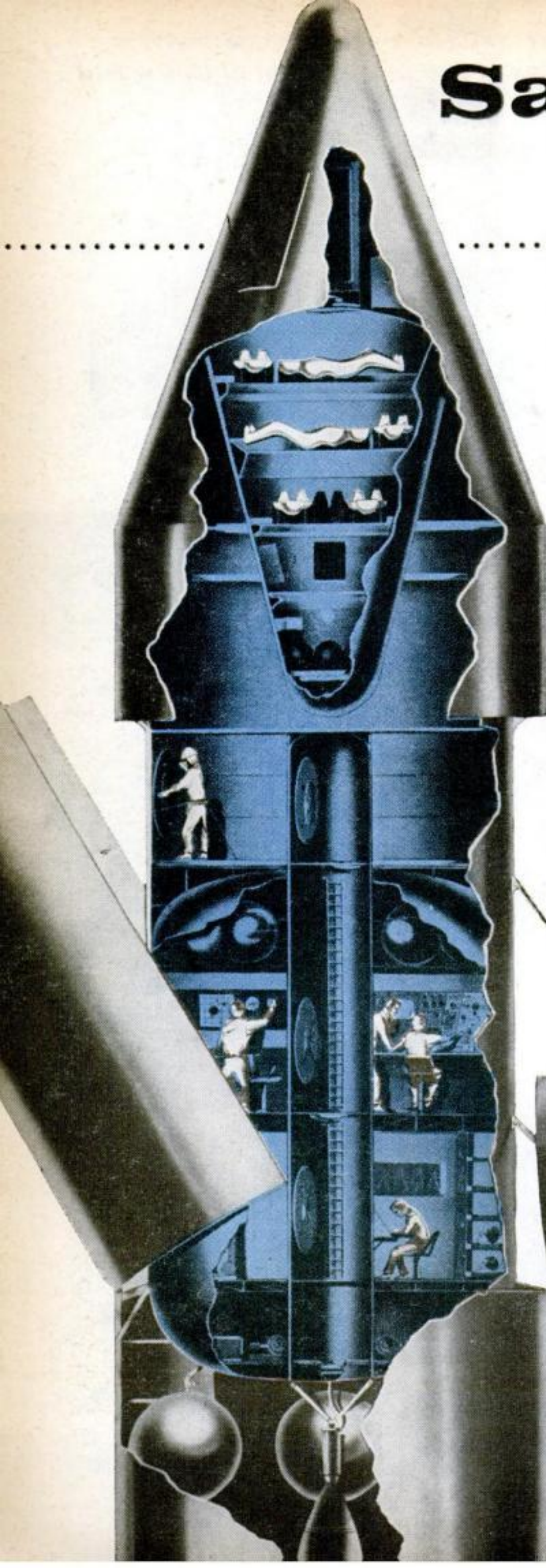
For the world's heftiest general-purpose forklift truck, six automobiles are a fairly light load. The 35-ton-capacity Ranger 700, made by Clark Equipment Co., is designed for use in steel yards, lumber mills, and other outdoor industries.



Cabin with a picture-window view

A full-size aft window on each side is an innovation on the latest Piper Apache. The twin-engine plane, shown above, offers improved rear visibility for the pilot as well as a clear view for the occupant of the optional fifth seat.

Saturn: Our Biggest



MANNED SPACE LAB, Wernher von Braun thinks, will be flung into orbit by a later, even bigger version of the 185-foot, 580-ton Saturn rocket (above). The crew (left) would ride in the nose cone during launch and return journey. Those hinged shields on the lab's sides could collect solar rays for power or act as brakes.

**This mightiest U.S. rocket, with eight engines to launch it,
should match Russian ones at toting loads out of this world**

Bet in the Space Race

By S. David Pursglove

AMERICA'S hopes in the space race ride on a monster called Saturn. It is a gigantic, fantastically expensive super-rocket that even its planners call a calculated risk.

Saturn will have the power to send a man around the moon, put three men and a laboratory into orbit, or refuel other rockets in space. It will tower 185 feet, twice the height of the Jupiter-C that carried our first Explorer satellite to its path in the sky. Its size will make trouble long before it takes off. There are few rail or highway tunnels large enough for the brute's 22-foot diameter.

Wernher von Braun and his National Aeronautics and Space Administration team made this giant by tying groups of smaller rockets together. You'd think that would just be asking for more headaches than rocketeers have already. Instead, Saturn's huge first-stage booster, a cluster of eight engines, has worked so well in its earth-shaking trials that only 10 test launchings of the complete rocket are scheduled. There's optimistic talk of getting along with fewer. This is amazing, for lesser rockets have had to have

as many as 120 try-outs before engineers were satisfied.

The U. S. needs a large, immensely powerful rocket in a hurry, if only to match the propaganda roar of Russia's mighty birds. Saturn is the answer.

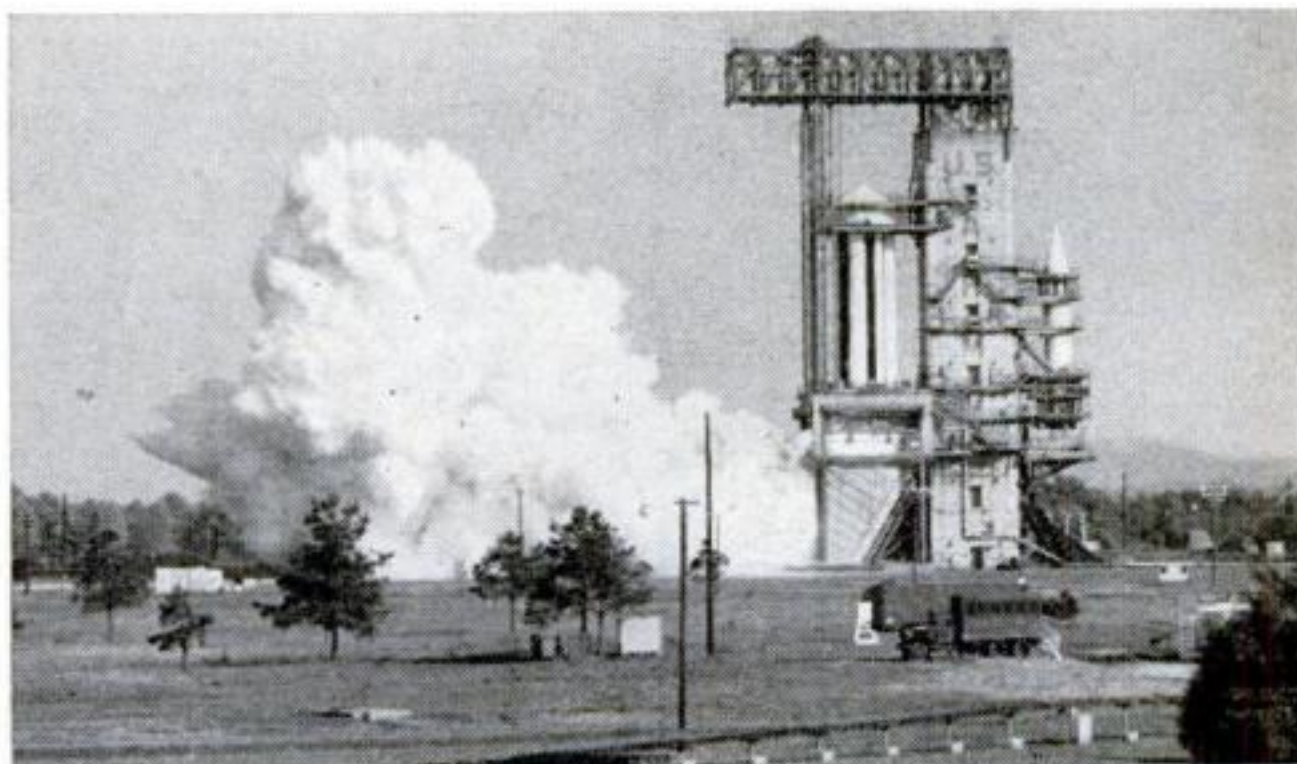
It's the *only* answer. Limited funds and scant time add up to this: There can be only one all-out effort to build the much-needed super-rocket. All of our eggs have to be in one basket.

That's the policy. To make it work, von Braun's former Army team tried tricks that haven't been used before.

For instance, long after Saturn's construction was under way, a special council in N.A.S.A. reached an agonizing decision. They decided to gamble on a lusty new propellant combination—liquid hydrogen and liquid oxygen. It will replace the conventional kerosene and liquid oxygen in Saturn's upper stages, and deliver about a third more oomph. But it is a newcomer. It is not used in any operational rocket.

How will the new propellant act? Scientists know only what it does in the laboratory. This was enough for N.A.S.A. The high-energy fuel can give Saturn the extra power needed to lift Russian-sized

THUNDEROUS POWER of Saturn's eight booster engines, generating 1.5 million pounds of thrust at full throttle, here shakes the Alabama countryside in a static test of the cluster. The booster alone is taller than the Jupiter missile, seen near it on a test stand at Huntsville, where the first Saturn rocket is being built.



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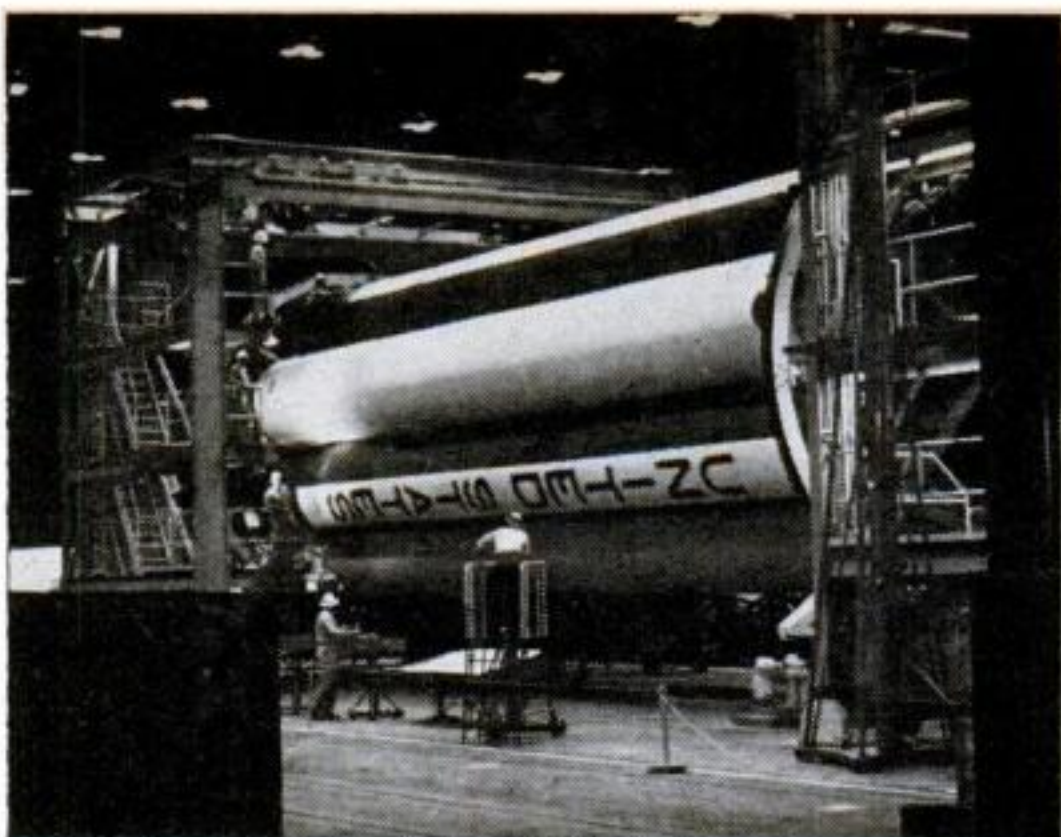
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loads. Under the calculated-risk policy, that decision had to be an all-or-nothing gamble. There is no parallel program to provide standby kerosene-fed upper stages if the hydrogen system doesn't pan out.

Sheer size makes the conventionally fueled first-stage booster the key to Saturn's tremendous power. The booster alone produces 1.5 million pounds of thrust, equivalent to 30 million horsepower. The entire Atlas ICBM produces only a fourth of this amount. (Russia's Pacific test rockets may have nearly matched Saturn's thrust; earlier Sputnik and Lunik rockets produced 500,000 to 800,000 pounds.)

The booster's eight Rocketdyne engines are the reliable Jupiter and Thor engines, redesigned to make them simpler and more compact. The starting system and fuel pump were taken from the top of the engine and mounted on the side to reduce length. The starting system was simplified. Now each engine fires and runs until it is up to thrust. When the total push of the booster is right, it launches. In the old way, a complex valve system measured chamber pressure and regulated fuel flow. The idea was to command a specified thrust, equal in all engines, at a certain time. Now, each engine is given its head, and Saturn waits until all engines are ready.

Why cluster the engines? Why not just build a new one powerful enough for the job? When aircraft engines neared the



EIGHT FUEL TANKS, four of kerosene and four of liquid oxygen, are assembled around a ninth, also containing LOX, in Saturn booster. Huge booster is 85 feet long and 22 feet in diameter.

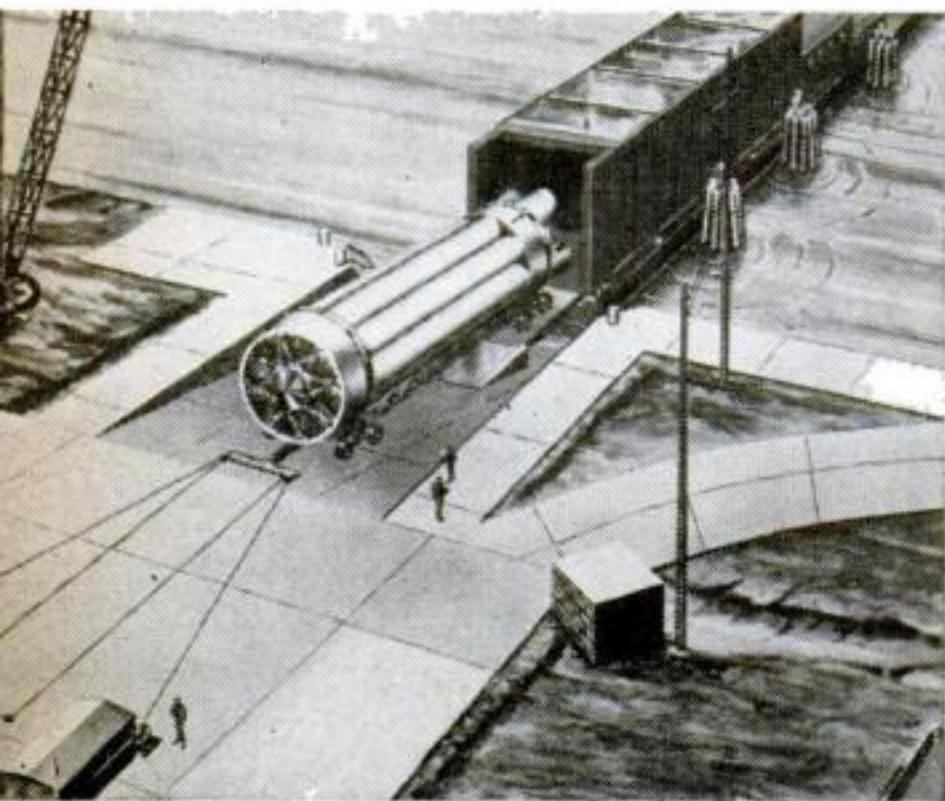
maximum practical size, boosts in power were gained by using several of them together. This won more than extra power. It added a safety factor. The same is true of Saturn. If a number of its engines fail, a range safety officer can use the others to guide the 580 tons of metal, kerosene, hydrogen, and oxygen to a safe crash area.

Clustering also allows Saturn to perform a stunt denied other rockets. It can complete its mission even if one or two engines fail. This may mean, sometimes, that Saturn will carry out an alternate, less demanding, mission. Often, though, it will be able to finish the job it set off to do, for it will be underloaded to allow for failure of several engines. If an engine cuts out, propellants that normally would flow to it can be rerouted to other engines.

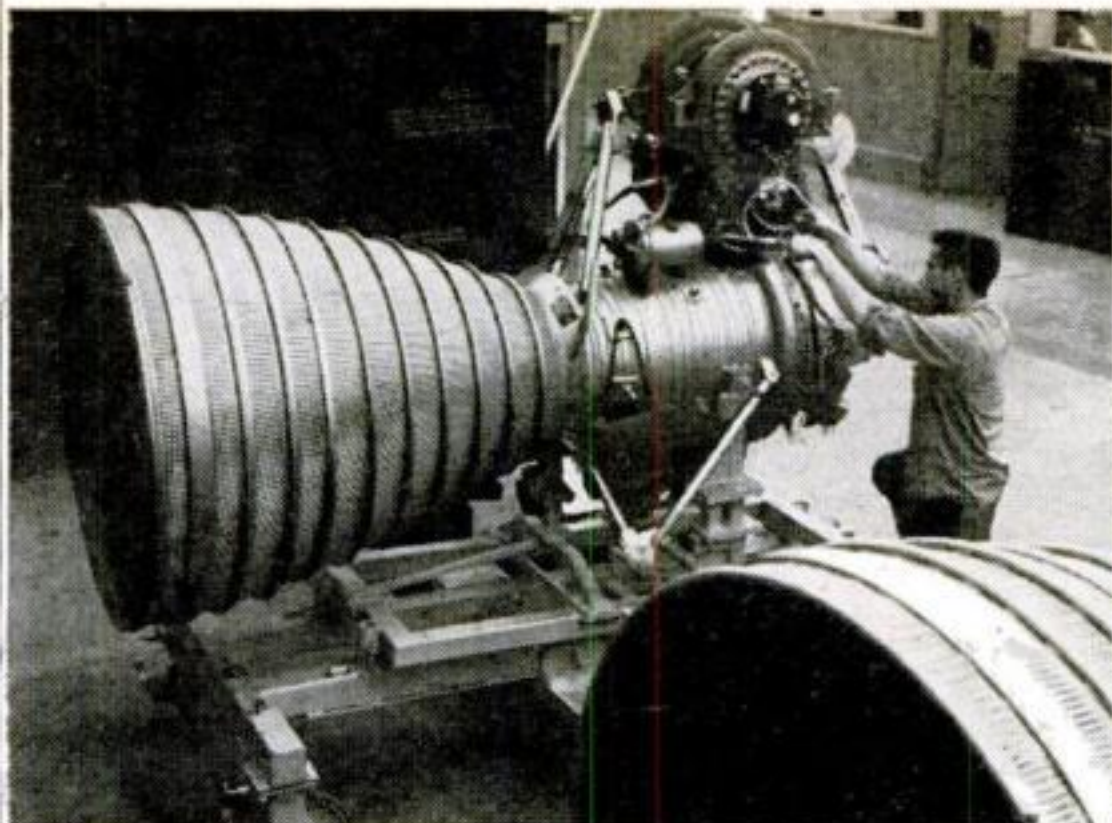
With this in mind, engineers can program each mission two ways: (1) Use each engine at just under full thrust to get to a point in a hurry; (2) use fewer engines, at full thrust, for a longer time and perhaps reach the target point in space a little later. The first plan would guide Saturn from its launching pad and probably control it for the rest of its flight. But if engines fail, the second program can take over.

Firing up. Here is how Saturn will be fired up and launched:

A single electrical signal will fire eight small charges of solid fuel at split-second



TOO BIG FOR TUNNELS on railroads or highways, the Saturn booster is expected to travel from Huntsville, Ala., to Cape Canaveral, Fla., in a special barge on three rivers and the ocean.



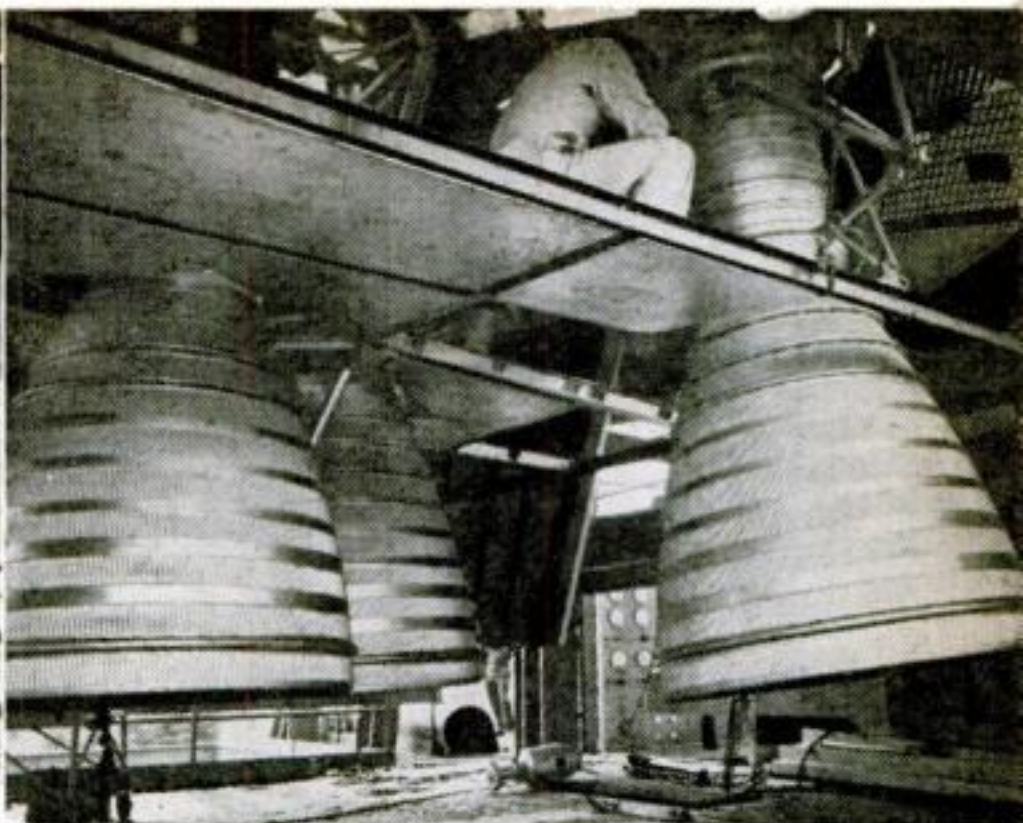
SIMPLIFIED ROCKET ENGINES, with complex of turbopump, starter, and fuel control mounted beside combustion chamber instead of on top, help make Saturn's booster more dependable.

intervals. Each charge creates expanding gases to spin the turbopumps that shoot propellants into the combustion chamber. The charge also breaks a thin seal and lets triethyl aluminum pour into the chamber. When this hits the other liquids, combustion is spontaneous.

Eight huge clamps grip the awesome bird tightly to its launching pad. About $1\frac{1}{2}$ seconds after the first solid charge fires, the chamber pressures of all eight engines should be high enough for launching. If so, four of the clamps slide back three feet on tracks. In doing this, they hit switches, and the other four clamps flip away, allowing the roaring, straining beast to begin its climb skyward.

If an engine fails to get up to power at launch, special instruments signal the stop mechanism instead of the clamp-release system. The stop signal fires a small solid charge that counteracts the starting charge and stops the turbopump on the sick engine.

N.A.S.A. plans to try to recover Saturn boosters for study—and to save money. Engineers may be able to use the whole booster again in later launchings. They almost certainly will re-use parts. About 100 miles downrange from Cape Canaveral, the second stage will separate from the booster. The huge, falling hunk of metal will then try to stop itself. It will release its first speed brake. That may be a large balloon or solid piece of metal on a cable. Or it may be a hinged



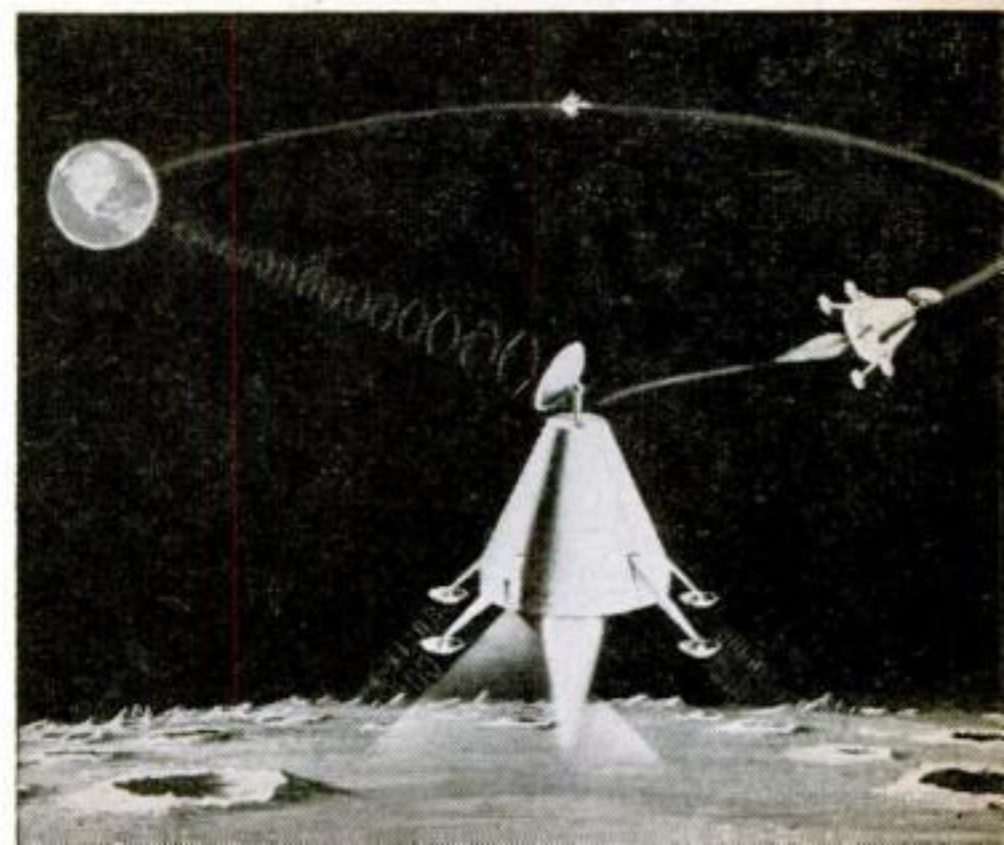
FOR DIRECTIONAL CONTROL, the rocket booster's four outboard engines can move through an arc of seven degrees. A workman is adjusting one here. Two of the inboard engines are at left.

lid opening outward from the booster's top. (N.A.S.A. engineers are not sure yet.) Whatever it is, it will have to cut the booster's speed from about 3,200 to 900 m.p.h. Next, a "parachute"—a single long strip—will stream out and trim the speed to about 500-600 m.p.h. Then three parachutes, each 105 feet in diameter, will blossom to slow the hurtling object to 80-90 feet a second.

By this time, the booster will be nearly in the water. Dangling from it will be a 100-foot cable with a water-activated electrical switch on the end. When the booster is 100 feet above the ocean, water will hit the switch and fire eight tiny solid-fuel retro rockets, pointing downward from the booster's skirt. Their cush-

[Continued on page 234]

LANDING ON THE MOON may first be achieved by a 2,400-lb. payload of scientific instruments and radios hurled there by Saturn. Its arrival would be cushioned by a retro rocket.





SUPPLY SHOP services stations and garages in Hawthorne-Inglewood-Westchester area near Los Angeles. Half of business is by "airmail."

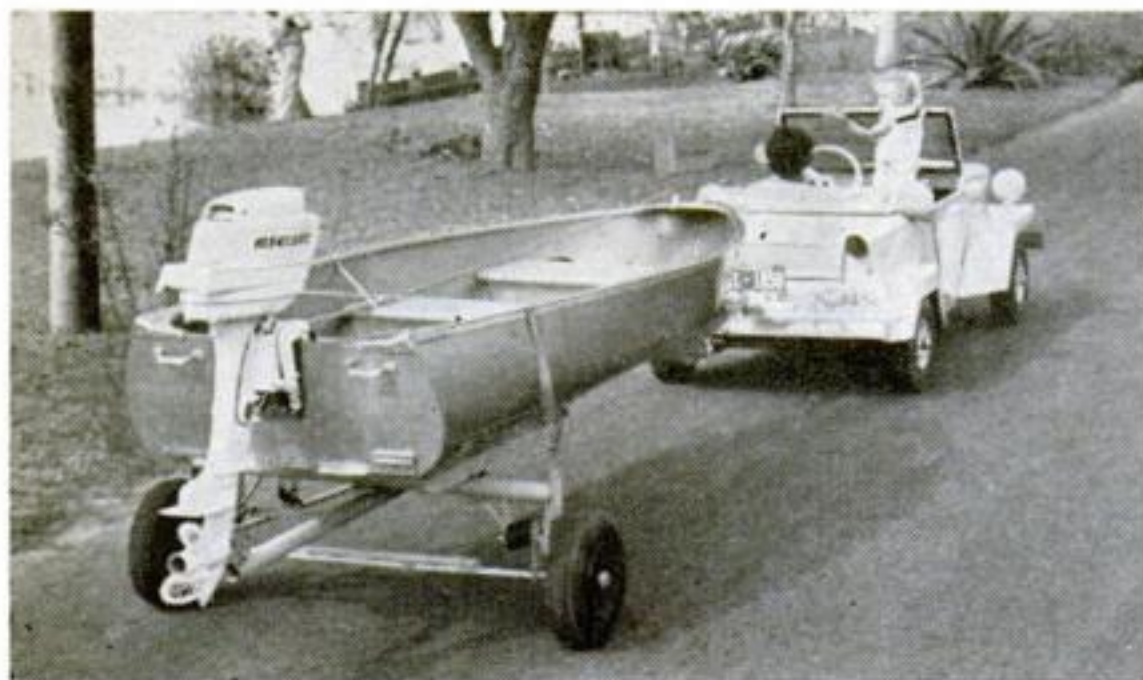
Auto-parts service by carrier pigeon

When a service-station owner who is a customer of Joe Kestler's auto-supply house in Hawthorne, Calif., needs a part he doesn't have, he can order it by carrier pigeon if it's for a rush job—and have it delivered in 15 to 30 minutes.

Kestler maintains a loft for some 30 pigeons at the back of his store. Every morning his son cages pigeons and delivers them by truck to about two dozen service-station and garage customers in the area. Pigeons not used to order un-

stocked parts during the day are returned in the evening for feeding.

The communications system was set up by Al Jacobson, a pigeon-fancier friend, who learned about carriers in the Signal Corps in World War I and has served as president of the California State Racing Pigeon Association. It has a double purpose. Besides saving costs at shops having only a coin phone, it's good advertising and public relations, provides about half of Kestler's business.



Compact combo

Here a midget car tows a small boat and a light outboard off for a little Florida fishing.

The boat is an 11 $\frac{1}{3}$ -foot aluminum skiff from Feather Craft, Inc., Atlanta, Ga.; the motor a 10-hp. Mercury; and the car a 9 $\frac{1}{4}$ -hp. King Midget put out by Midget Motors Corp., Athens, Ohio. Boat, motor, and trailer sell for less than \$750, car for just over \$800.



1. CAGED HOMING PIGEONS are delivered each morning by truck to about two dozen service stations dealing with Community Auto Supply.



2. CARRIER TAKES WING and is off with a request for immediate delivery of an auto part not in stock and needed for a quick repair job.

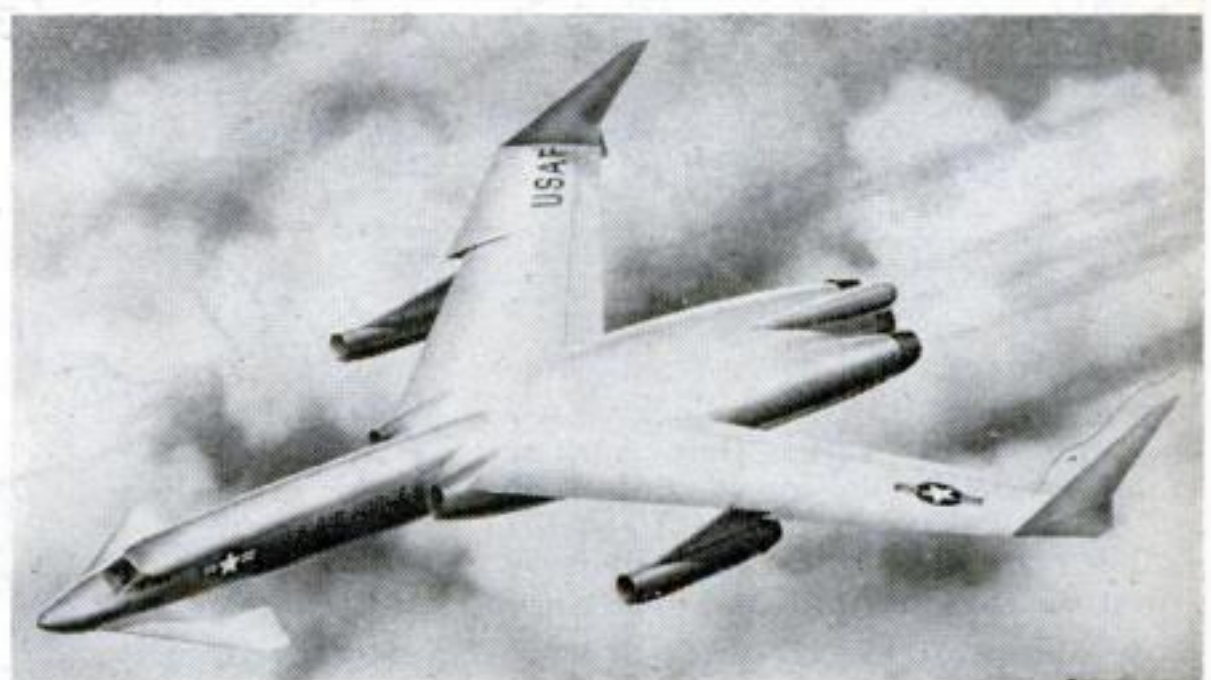
3. LANDING ON HINGED PERCH minutes later, the pigeon closes a switch circuit and sounds an alarm that brings owner's son on the double.

4. NOTE IN LEG CAPSULE describes part needed and gives name of service station that wants it. Kestler's delivery truck takes over.



Nuclear plane being designed

One of several versions of an atomic-powered aircraft being planned by Convair for the Air Force is shown in the drawing at right. The plane would fly on direct-air-cycle nuclear engines mounted behind a shield in the tail and on two conventional jets under the wings. GE is building the atomic engines.



How a Taxi Meter Works

IN ANCIENT Rome, some hired vehicles had a primitive taxi meter. A compartmented wheel driven by a road wheel dropped pebbles from a hopper into a box. Counted at the end of the ride, these set the fare.

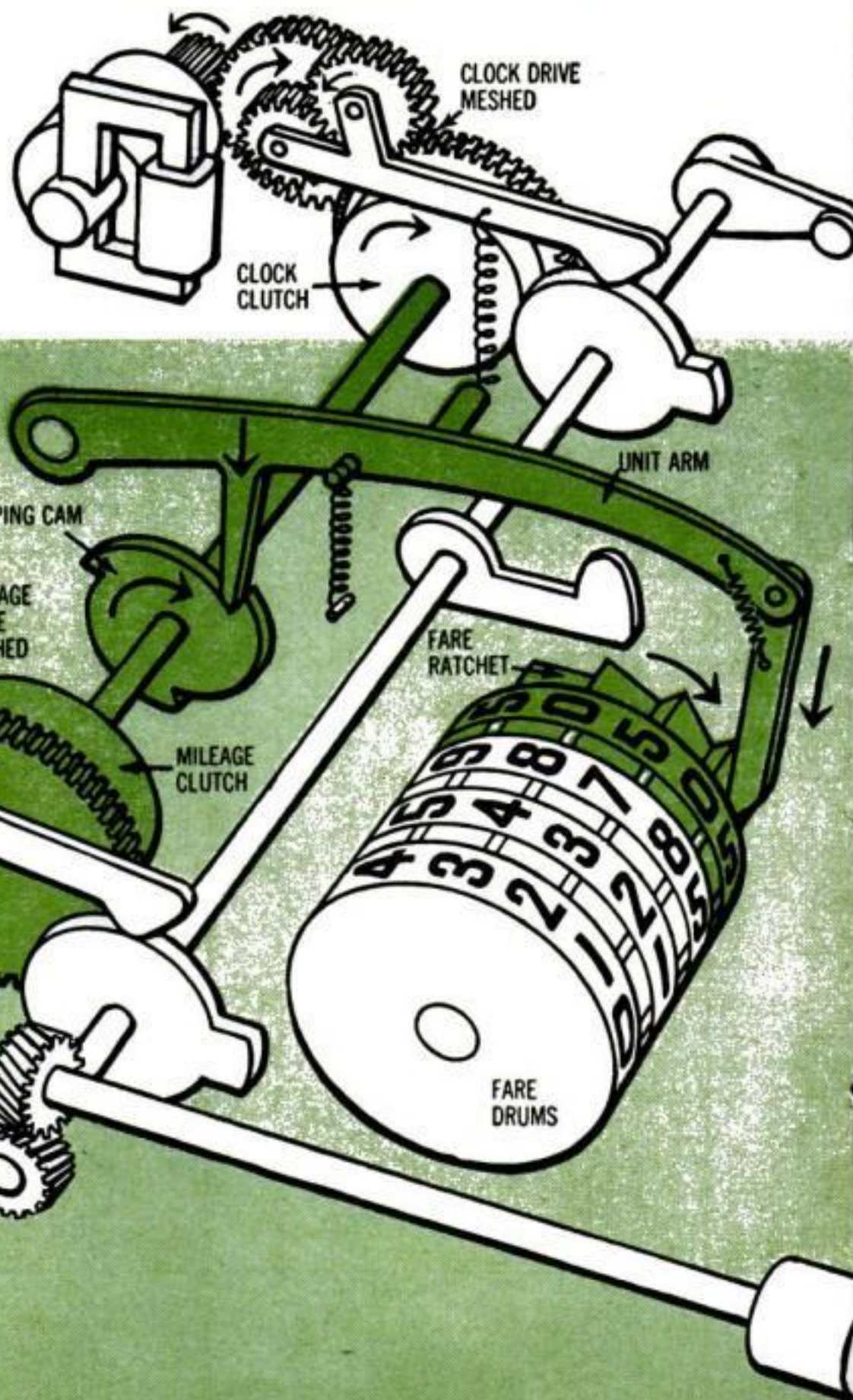
Modern taxi meters can be set to run at any of 134 cab rates now prevalent, to charge various legal waiting rates, even to meet special regulations (as in Connecticut, where time charges legally begin only after six minutes). Also preset is the minimum fare, the initial mileage after which fare mounts, and the precise intervals at which charge units—nickels

or dimes—click up as tariff demands.

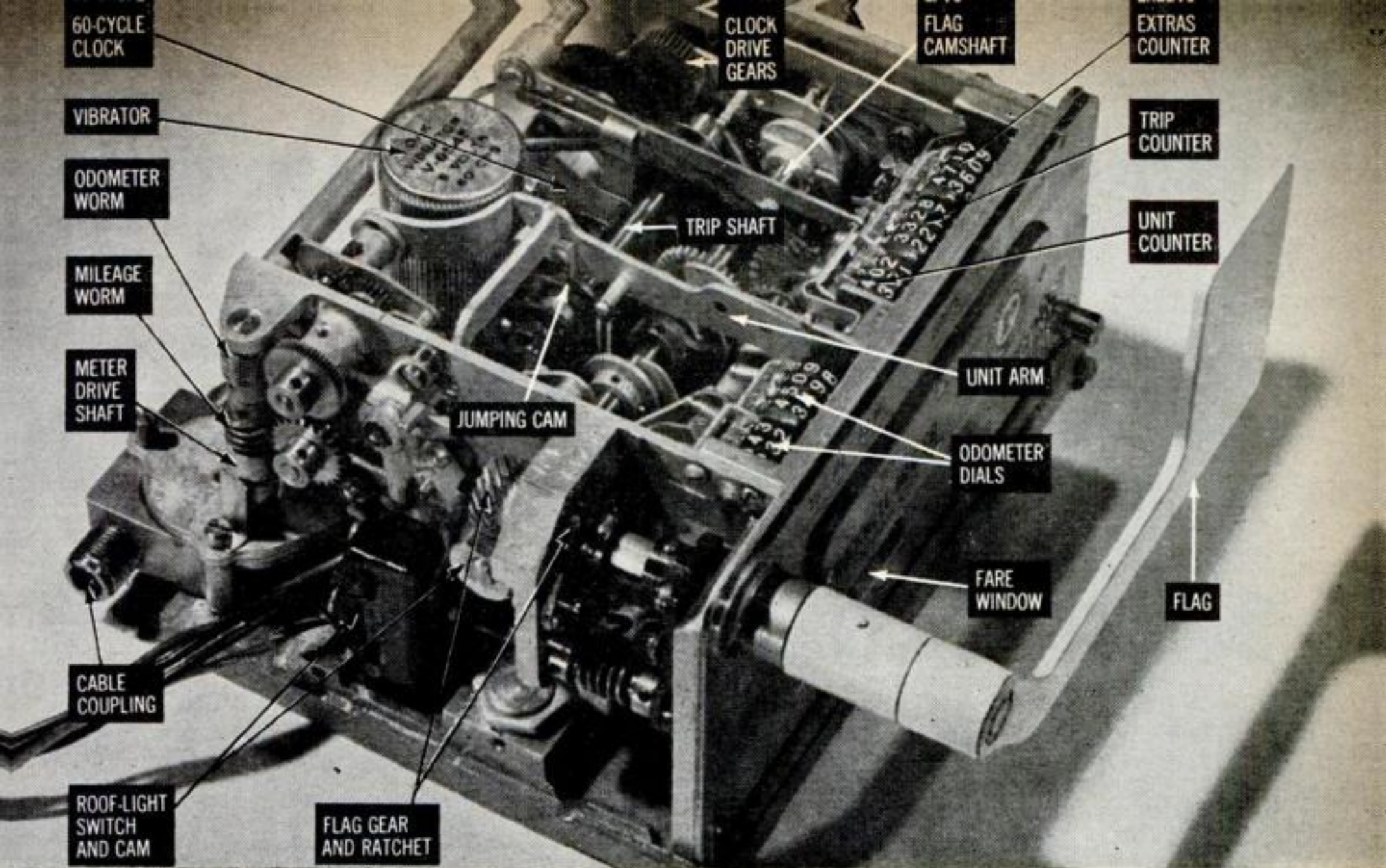
It's the time factor that may make the same trip cost different amounts. Mileage and traffic waits both add up on the fare drums. A fast ride with few delays costs less than the same trip in stop-and-go traffic. Minor variables that may save you a few cents on long trips: over-size tires, high air pressure, chains. These take you a bit farther per wheel revolution. Heavy loads and worn or soft tires do the opposite.

City ordinances usually allow only 100-foot-per-mile error in taxi meters. A Rockwell Ohmer meter is shown here.

TIME AND DISTANCE COMPETE to trip the fare drum. At the flag drop, a clock starts to turn the trip shaft, charging for waiting time. When cab rolls, the mileage drive turns the same shaft. An over-running, or one-way, clutch at each end lets the slower drive slip. If rates are \$3 an hour and 30 cents a mile, a cab moving only 10 m.p.h. clocks the standing rate.



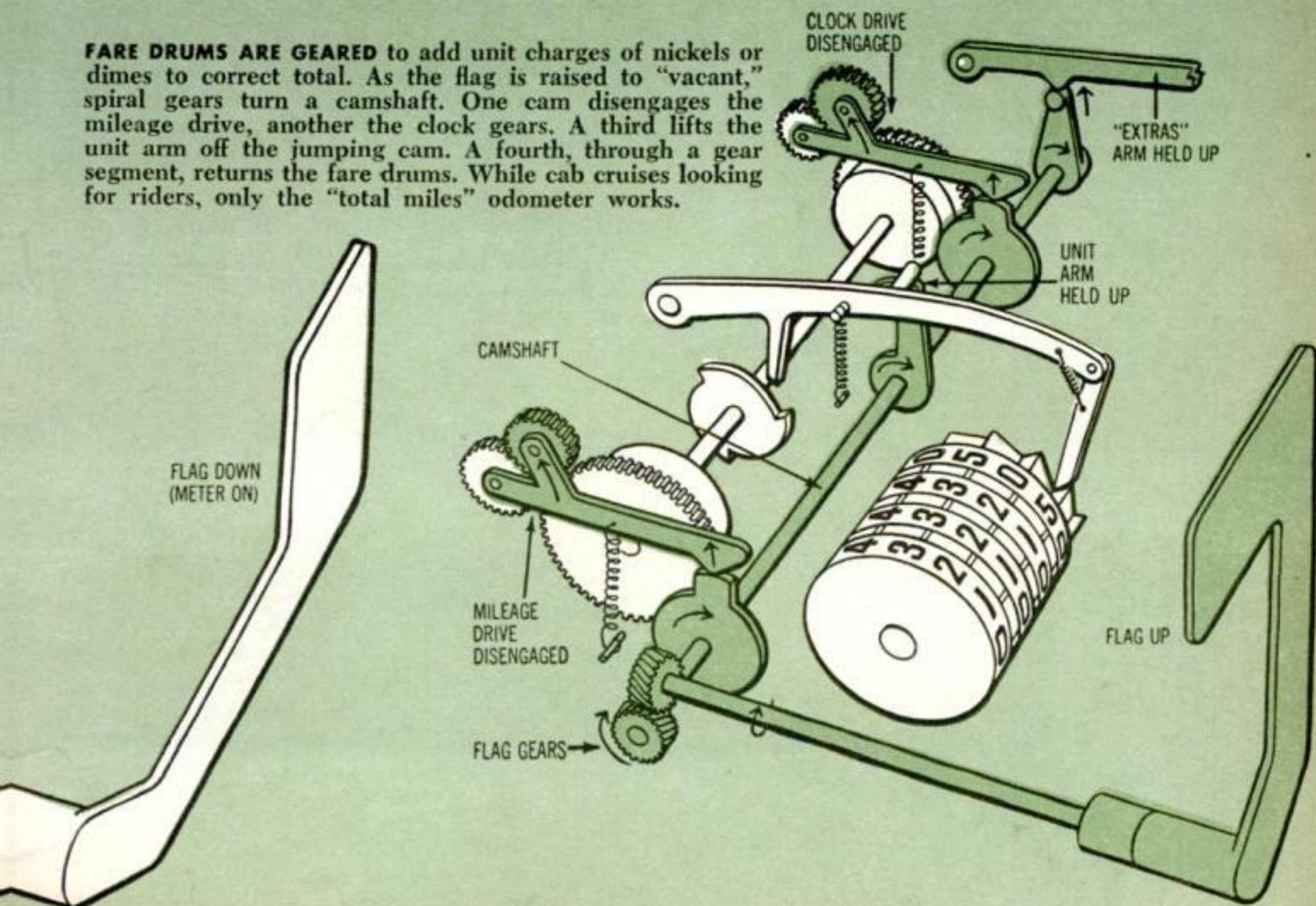
AT ROAD SPEEDS, the mileage drive outruns the clock. In traffic waits, the clock clutch engages and meter reverts to time charges. Either way, a three-lobed cam on unit shaft first raises, then drops unit arm. Each lift moves unit counter one digit (see photo); each drop advances fare ratchet one tooth.



THE FARE'S FAIR, for meters (usually checked and sealed by city authorities) are geared to suit tire size and rear-axle ratio, to charge only legal rate for waiting, and to bill riders at ad-

vertised rates. The complex box not only prices each ride but registers the fare, paid and unpaid mileage traveled, number of trips, and extras (trunks, extra riders if number is limited).

FARE DRUMS ARE GEARED to add unit charges of nickels or dimes to correct total. As the flag is raised to "vacant," spiral gears turn a camshaft. One cam disengages the mileage drive, another the clock gears. A third lifts the unit arm off the jumping cam. A fourth, through a gear segment, returns the fare drums. While cab cruises looking for riders, only the "total miles" odometer works.



There's plenty of room at the bottom, says noted scientist as he reveals—

How to Build an Automobile



At 42, Richard Phillips Feynman, Ph.D., enjoys world renown as a theoretical physicist, local fame as a "marvelous" performer on the bongo drums, and campus admiration as a man with a pixyish humor that turns a lecture on quantum electrodynamics into a ball. You'll see why when you read his impassioned and witty plea to think small.

This tall, slim, dark-haired scholar helped importantly in developing the atomic bomb and watched its first test explosion. In 1954 he won the \$15,000 Albert Einstein Award, one of the nation's highest scientific honors.

He is capable both of exuberant fellowship and of rather stern withdrawal, especially when pondering intricate problems. Even his heavy thinking has a light touch, however. In deepest thought, while pacing the floor, he slowly flips a silver dollar back and forth across the fingers of his right hand by carefully controlled movements of the knuckles. It's no easy trick even when you have nothing else to think about.

Born in New York City in 1918, he graduated from MIT in 1939 and got his Ph.D. at Princeton in 1942. He was a member of the Laboratory of Nuclear Studies at Cornell from 1945 to 1950. In 1950, he began his present job as professor of theoretical physics at Caltech.

Dr. Feynman loves music, children, camping in the wilds, and unpremeditated jaunts to faraway places. He boned up on Portuguese to become a visiting lecturer for two seasons in Brazil, and learned Spanish under forced draft to go to Peru and poke around Inca ruins.

The accompanying article is condensed from a speech (addressed to an American Physical Society meeting, not the Pasadena Rotary luncheon). The full transcript appeared in "Engineering and Science Magazine," published at the California Institute of Technology.

Exploring the fantastic possibilities of the very small should pay off handsomely—and provide a lot of fun, too

By Richard P. Feynman

*Professor of Theoretical Physics,
California Institute of Technology*

PEOPLE tell me about miniaturization, about electric motors the size of the nail on your small finger. There is a device on the market by which you can write the Lord's Prayer on the head of a pin. But that's nothing. That's the most primitive, halting step.

Why not write the entire 24 volumes of the "Encyclopaedia Britannica" on the head of a pin?

Let's see what would be involved. The head of a pin is a sixteenth of an inch across. If you magnify it 25,000 diameters, the area of the head of the pin is equal to the area of all pages of the encyclopedia. All it is necessary to do is to reduce the writing in the encyclopedia 25,000 times. Is that possible? One of the little dots on the fine halftone reproductions in the encyclopedia, when you demagnify it by 25,000 times, still would contain in its area 1,000 atoms. So, each dot can easily be adjusted in size as required, and there is no question that there is enough room on the head of a pin to put all of the "Encyclopaedia Britannica."

IMAGINE that it is written in raised letters of metal that are 1/25,000 ordinary size. How would we read it?

We would press the metal into plastic and make a mold; peel the plastic off very carefully; evaporate silica into the plastic to get a very thin film; then shadow it by evaporating gold at an angle against the silica so that all the little letters appear clearly; dissolve the plastic away from the silica film; and then look through it with an electron microscope.

Smaller Than This Dot ▶.

How do we write it? Reverse the lenses of the electron microscope to demagnify. Ions, sent through the lenses in reverse, could be focused to a very small spot. We could write with that spot as we write in TV, by going across in lines, and having an adjustment that determines the amount of material that is deposited.

Don't tell me about microfilm!

THERE is *plenty* of room at the bottom—not just room at the bottom. I want to show what is possible according to the laws of physics. I am not inventing antigravity, which is possible only if the laws are not what we think. I am telling you what could be done if the laws *are* what we think; we are not doing it simply because we haven't yet gotten around to it.

How many times when you are working on something frustratingly tiny, like your wife's wrist watch, have you said, "If I could only train an ant to do this!" I suggest training an ant to train a mite to do this. What are the possibilities of

small but movable machines? They may or may not be useful, but they surely would be fun to make.

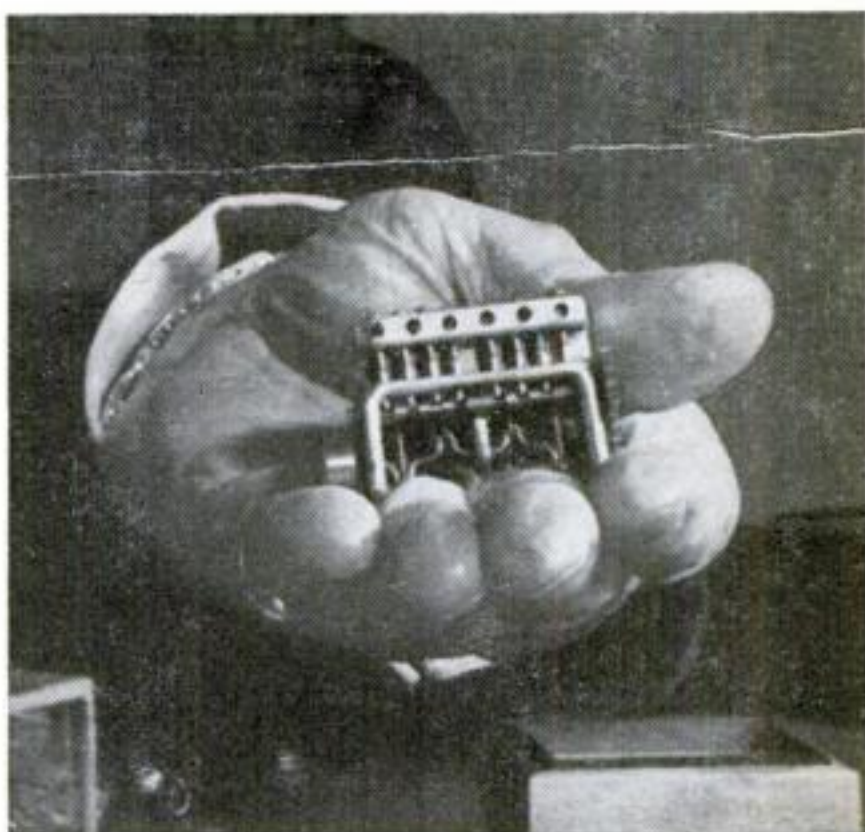
CONSIDER an automobile. Suppose we need an accuracy of $4/10,000$ of an inch. If things are more inaccurate than that in the shape of the cylinder and so on, it isn't going to work very well. If I make the thing too small, I have to worry about the size of the atoms; I can't make a circle out of "balls" if the circle is too small.

So, let's say I make the error, corresponding to $4/10,000$ of an inch, correspond to an error of 10 atoms. I can reduce the dimensions of an automobile 4,000 times, approximately—so that it is $1/25$ inch across.

In such small machines the forces go as the area you are reducing, so that weight and inertia are of relatively no importance. The strength of material is very much greater in proportion. The stresses and expansion of the flywheel from centrifugal force, for example,



THIS IS TOO EASY, says Professor Feynman of Lord's Prayer written on pinhead (above). He shows how 24-volume encyclopedia could be reproduced—in letters and pictures—on pinhead with standard tools and techniques. If coding system were used, every book ever written could be copied into a barely visible speck of dust.



IS THIS THE SMALLEST ENGINE YET BUILT? A model of a Ford four-cylinder, it is one of 33,000 miniatures in collection of San Francisco art expert Jules Charbneau. It is an exact copy with moving parts—but a long way from Professor Feynman's proposal for a complete, operating automobile measuring $1/25$ inch.

CONTINUED

would be the same proportion only if the rotational speed is increased as we decrease the size. On the other hand, metals have a grain structure and this would be very annoying at small scale. Plastics and glass are very much more homogeneous, and so we would have to make our machines out of such materials.

THERE are problems associated with the electrical system—copper wires and magnetic parts. The magnetic properties on a very small scale are not the same as on a large scale. The electrical equipment won't simply be scaled down. It has to be redesigned to work again.

Lubrication involves some interesting points. The viscosity of oil would be higher and higher as we went down. If we change from oil to kerosene or some other fluid, the problem is not so bad.

But we may not have to lubricate at all! We have a lot of extra force. Let the bearings run dry; they won't run hot because the heat escapes away from such a small device very, very rapidly.

This rapid heat loss would prevent the gasoline from exploding, so an internal combustion engine is impossible. Other chemical reactions, liberating energy when cold, can be used.

What would be the utility of such machines? Who knows? A small automobile would only be useful for the mites to drive around in, and I suppose our Christian interests don't go that far. However, although it is a very wild idea, it would be interesting in surgery if you could swallow the surgeon. You put the mechanical surgeon inside the blood vessel and it goes into the heart and "looks" around. It finds out which valve is the faulty one and takes a little knife and slices it out. Other small machines might be incorporated in the body to assist some inadequately functioning organ.

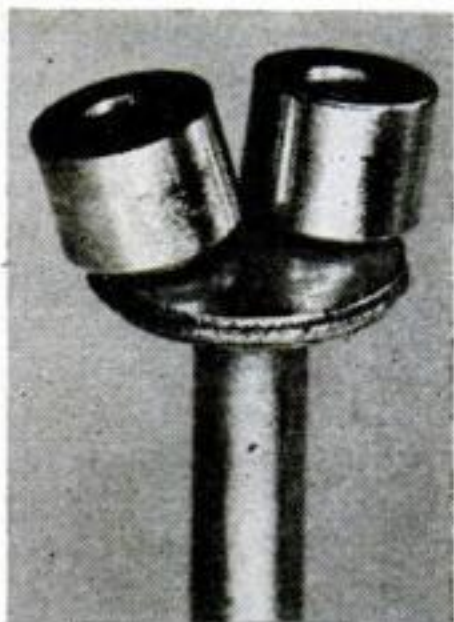
HOW do we make such a tiny mechanism? In atomic-energy plants they have materials they can't handle directly because they have become radioactive. To unscrew nuts and put on bolts, they

have a set of master and slave hands. By operating a set of levers here, you control the "hands" there, and can turn them this way and that so you can handle things quite nicely.

Most of these devices are made rather simply. A cable, like a marionette string, goes directly from the controls to the "hands." But things also have been made using servo motors, so that the connection is electrical rather than mechanical. When you turn the levers, they turn a servo motor, and reposition a motor at the other end.

I want slaves to be made one-fourth the scale of the "hands" that you ordinarily maneuver. So you can do things at one-quarter scale—the little servo motors with little hands play with little nuts and bolts; they drill little holes; they are four times smaller. Aha!

I manufacture a quarter-size lathe; I manufacture quarter-size tools; and I make, at the one-quarter scale, still another set of hands again relatively one-quarter size! This is $\frac{1}{16}$ size, from my point of view. And after I finish doing this I wire directly from my large-scale system to the $\frac{1}{16}$ servo motors. Thus I can now manipulate the $\frac{1}{16}$ -size hands.



SMALLEST MACHINES made commercially are pivot bearings—two fit on pinhead—for jet fuel meters, product of Miniature Precision Bearings.

IF YOU work through a pantograph, you can get much more than a factor of four in one step. But you can't work directly through a pantograph that makes a smaller pantograph—because of the looseness of the holes and the irregularities of construction. The end of the pantograph wiggles with a relatively greater irregularity than the irregularity with which you move your hands. In going down this scale, I would find the end of the pantograph shaking so badly it wouldn't be doing anything sensible.

At each stage, it is necessary to improve the precision of the apparatus. Having made a small lathe with a pantograph, we may find its lead screw irregular—more irregular than the large-scale one. We could lap the lead screw against breakable nuts that you reverse in the

[Continued on page 230]

New Ideas from the Inventors

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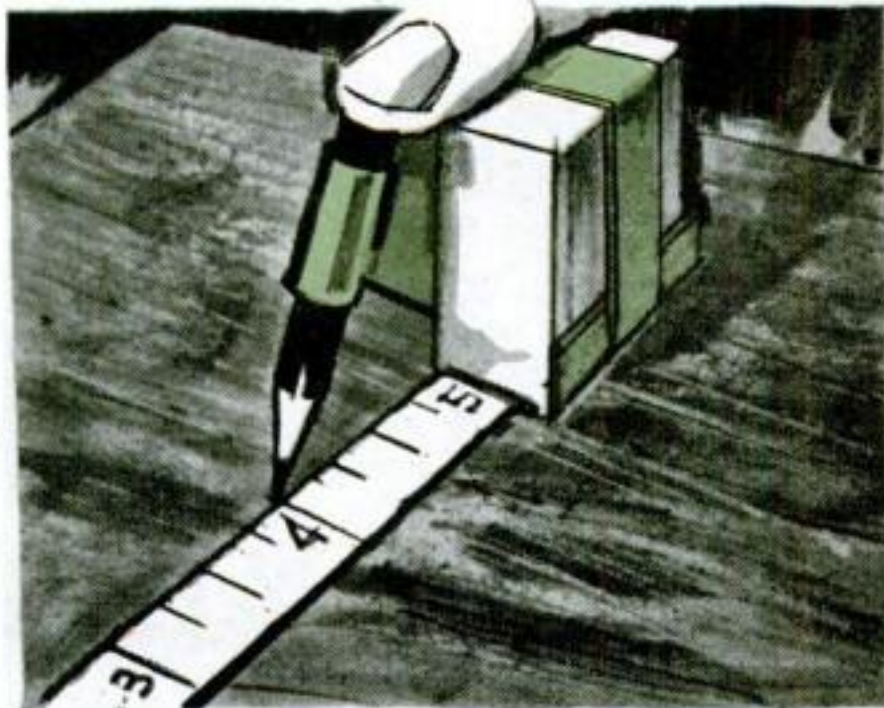


Scoops Help Stop Liner. Collisions of fog-bound vessels—which keep happening despite radar—might be averted by these recently patented drag anchors. They'd

be dropped from their deck housings to help slow or stop a ship in an emergency; for fast turns they could be released on one side of the vessel only.

Trunk Mat Chocks Wheels. You would not have to hunt for a block to change a tire if you carried this trunk mat. Bolted to the mat, the chock would be held by the car's weight and couldn't slip or be dislodged. Turned sideways, the mat would give traction in sand, snow, or mud.

Tape Holder Grips Marker. You could mark off measured intervals easily, accurately—and with one hand—if you slipped both tape and pencil into this combination holder. The offset clip would align the pencil tip with the edge of the tape; you'd mark a point by rocking the case.



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More Inventors' Ideas



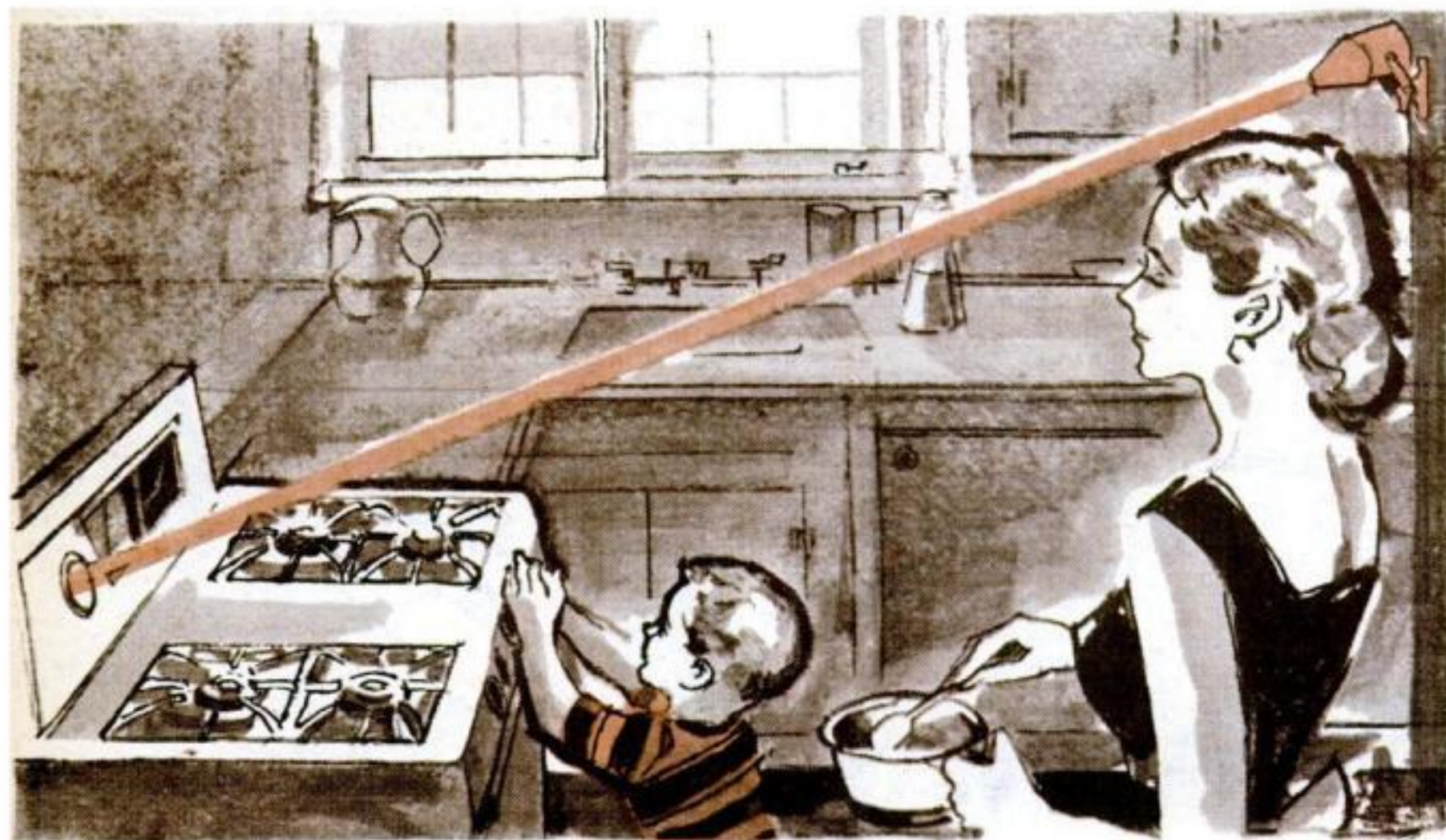
Paint Rollers Apply a Pattern. Raised designs on the outer sleeve of this two-roll applicator would print a pattern on any surface. You'd brush paint onto the inner roller, then work it over a sheet of paper to transfer a uniform film to the bosses on the outer roller.



Dual-Power Bike. You could drive the rear wheel of this bike by pedaling in the usual way, or propel the front wheel by pumping the handlebars up and down. The inventor says his bike would increase sprinting speed, ease hard climbs, and give exercise for arm muscles.

Stove Beam Foils Small Fingers. Heavy springs on the valves of this gas range would resist a child's efforts to light the burners. But the knobs would turn easily

for anyone tall enough to interrupt a light beam shining on a photocell. Breaking the beam would retract a plunger and ease the pressure on the springs.





Dimmer Adjusts Flashlight Glow. Turning the end cap of this flashlight would tighten—or loosen—the contact surfaces of a set of carbon disks. This would regulate the flow of current to the bulb and let you adjust beam intensity from full brightness to a faint glow.

Dustpan Sticks to Floor. You wouldn't need a helper—or a third hand—to hold this disposable cardboard dustpan or to keep sweepings from sliding under the dust-collecting edge. A sticky coating under the lip of the pan would keep it flat on the floor. If it wore away before the pan was ready for discard, a coated tape could be applied to replace it.



Car Door Lifts Roof Panel. A flip-top lid covered by a GM patent would help a tall motorist keep his head—and his hat—while getting in or out of a low-roofed car. The power-operated “flipper” would lift automatically as the door opened, retract after the door closed.

The following patents have been issued on these inventions: Ship drags—No. 2,923,267 to A. Jackson, Herkimer, N. Y.; Chock—No. 2,813,600 to G. Dyuricza, Farrell, Pa.; Tape holder—No. 2,807,886 to A. Aciego, Lawndale, Calif.; Roller—No. 2,805,436 to J. and H. Christensen, Kenosha, Wis.; Bike—No. 2,926,024 to W. Huebener, Cincinnati, and L. Blank, Covington, Ky.; Stove lock—No. 2,926,656 to P. Hale, Ypsilanti, Mich.; Flashlight—No. 2,810,822 to E. Hauser, Altoona, Pa.; Dustpan—No. 2,924,841 to H. Seibert, Baltimore; Car flipper—No. 2,815,977 to E. Podolan, Detroit.

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D. C., at 25 cents each. To write to an inventor, if the address given above is insufficient, you may address him (by name and patent number) in care of the Commissioner of Patents.



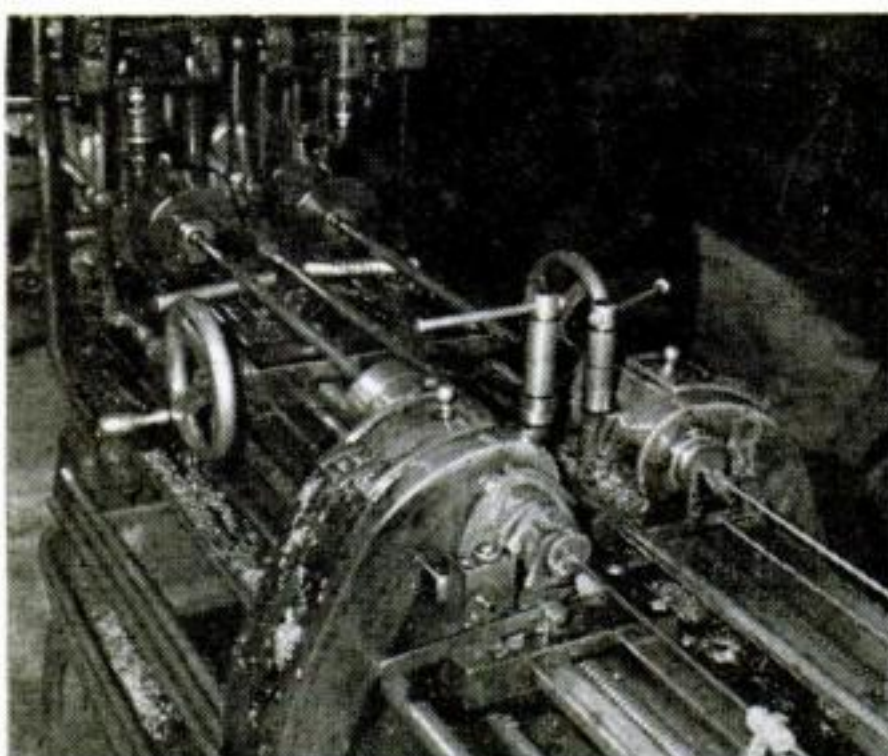
How They Put the Hole in a Rifle Barrel

A STEEL blank is fed into a humming machine tool. The hollow, stationary drill squirts cutting oil under 1,000-p.s.i. pressure as it bites away metal to .001-inch tolerances. In minutes an armload of barrels is bored.

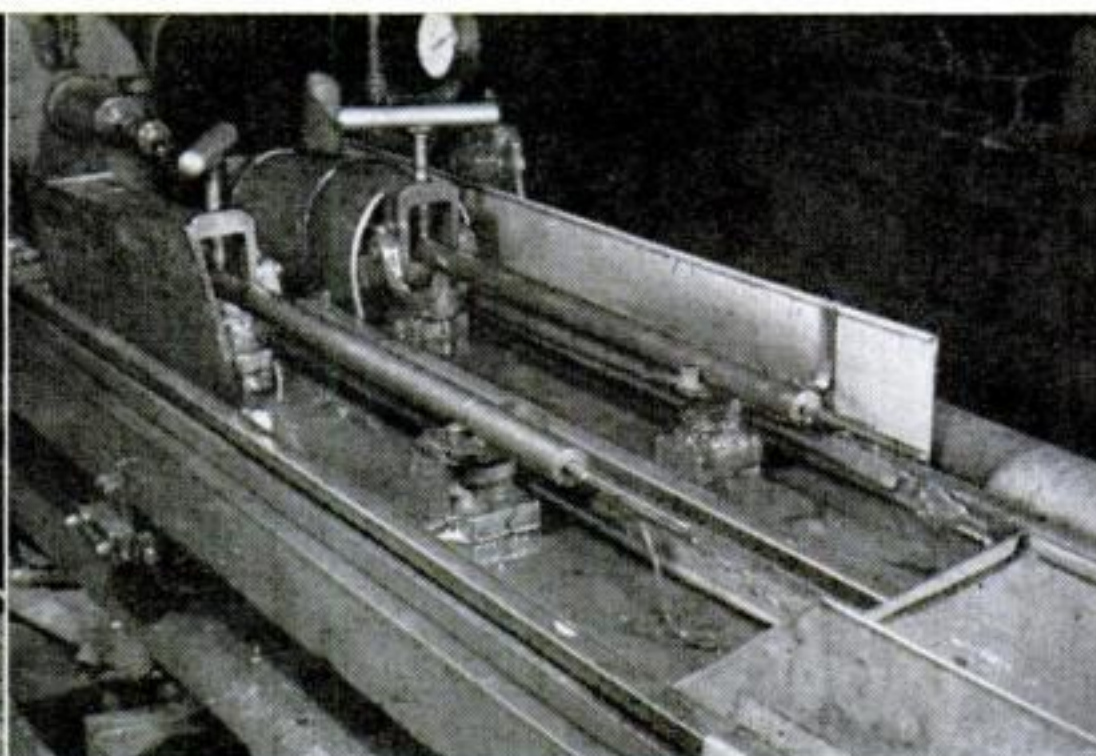
But in the same plant, a few craftsmen work painstakingly with the simplest hand tools on a single barrel at a time. Some operations still cannot be entrusted to machinery. Barrel straighteners, for instance, have the delicate job of correct-

ing slight bends in the bores. Such experts are especially in demand; in the not-too-distant past, their techniques often were family secrets.

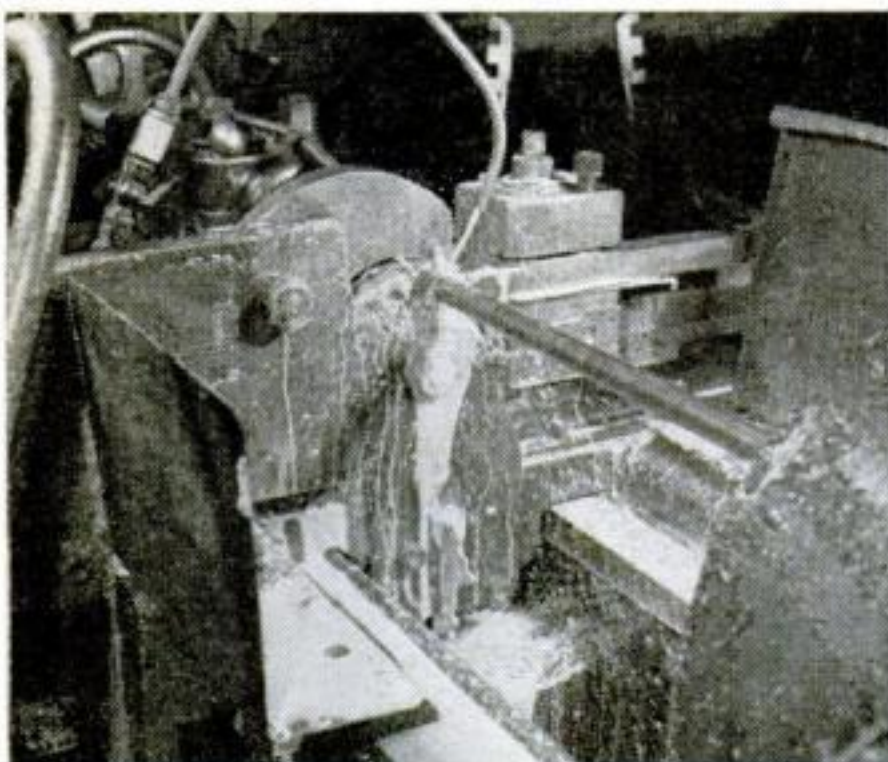
At Marlin Firearms, where these photos were made, some processes still are secret. For example, the Micro-Groove rifling machine, which forms a shallow, spiral groove in the bore that spins and stabilizes the bullet, was turned off and covered with a blanket when the PS photographer arrived.—*Alex Markovich.*



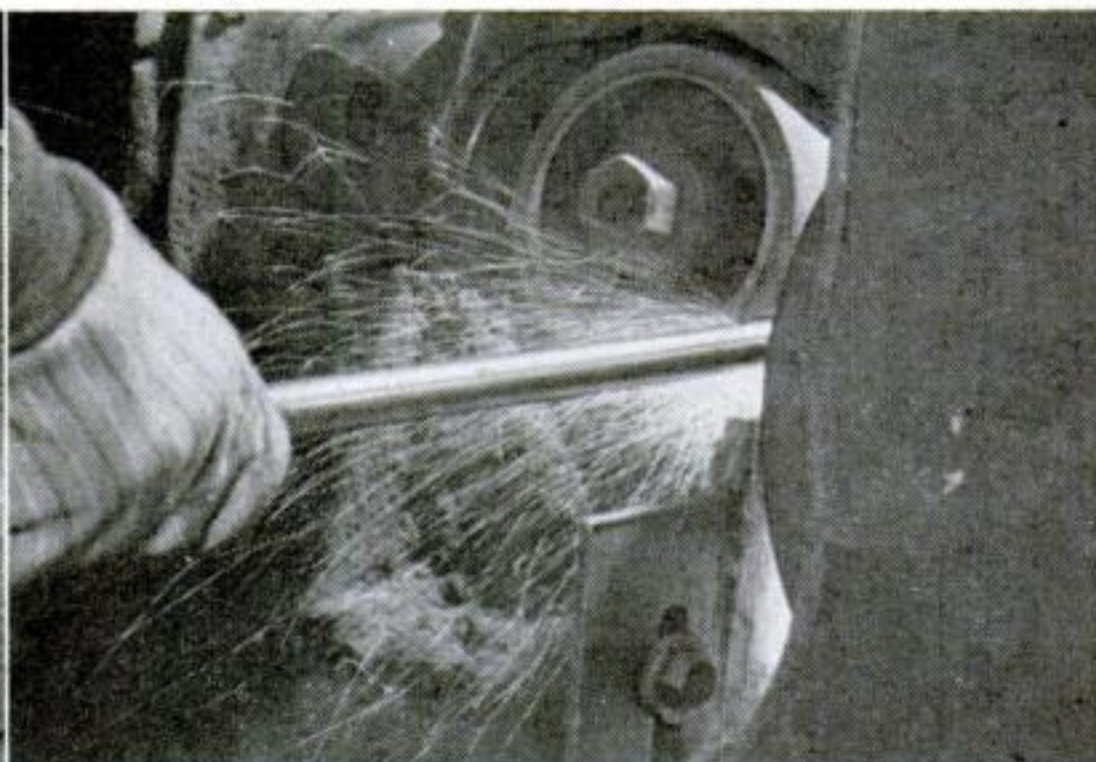
1 SPINNING at 3,400 r.p.m., steel blanks advance over fixed drills. Occasional maverick blanks with off-center bores are scrapped.



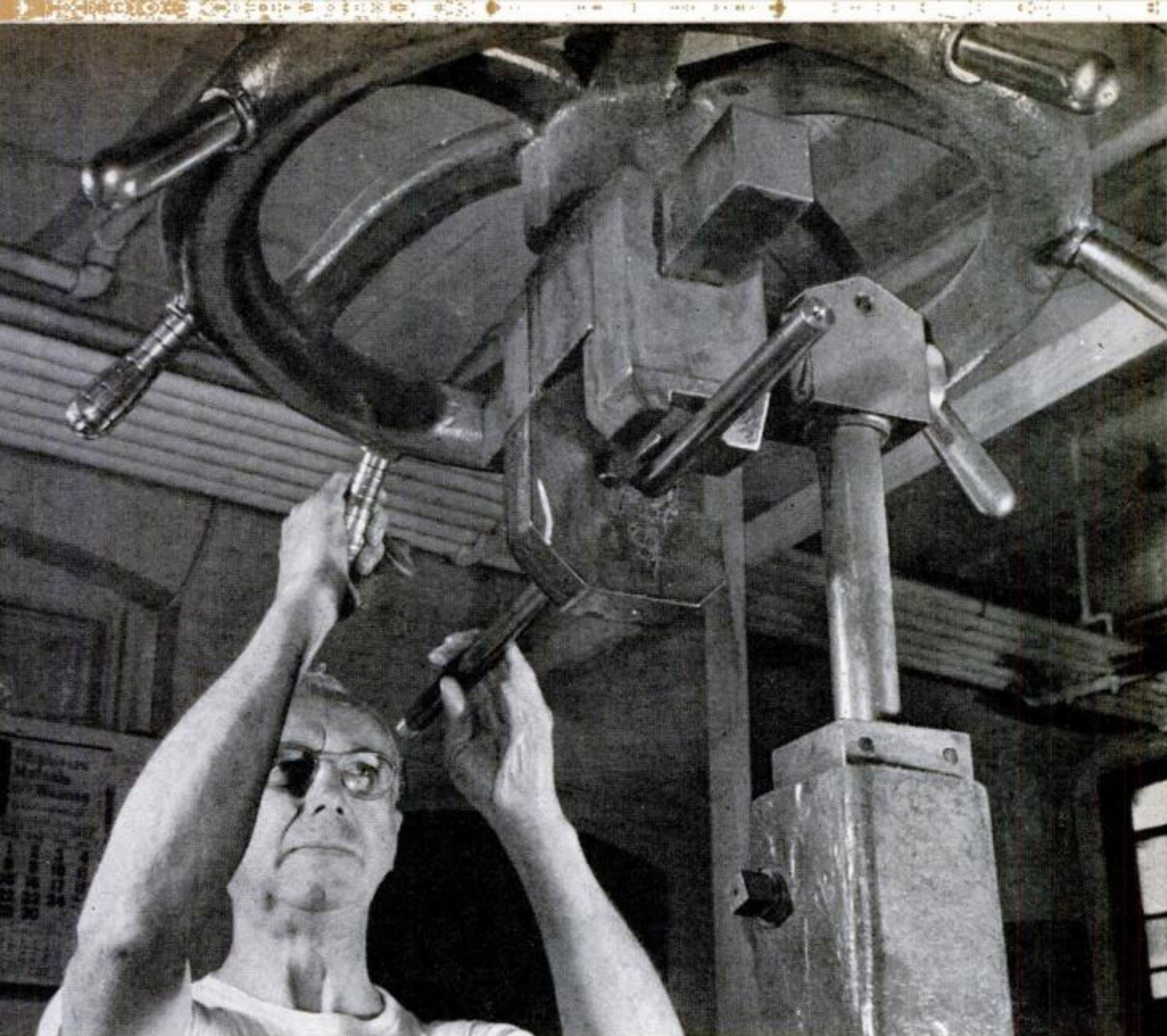
2 IMPERFECTIONS left by the drill are reamed smooth. Operators are alert for the chatter and damaging vibration of a dull tool.



4 AFTER BEING RIFLED, barrel is tapered on a lathe. A pattern consisting of shaped bar and follower insures uniform taper.

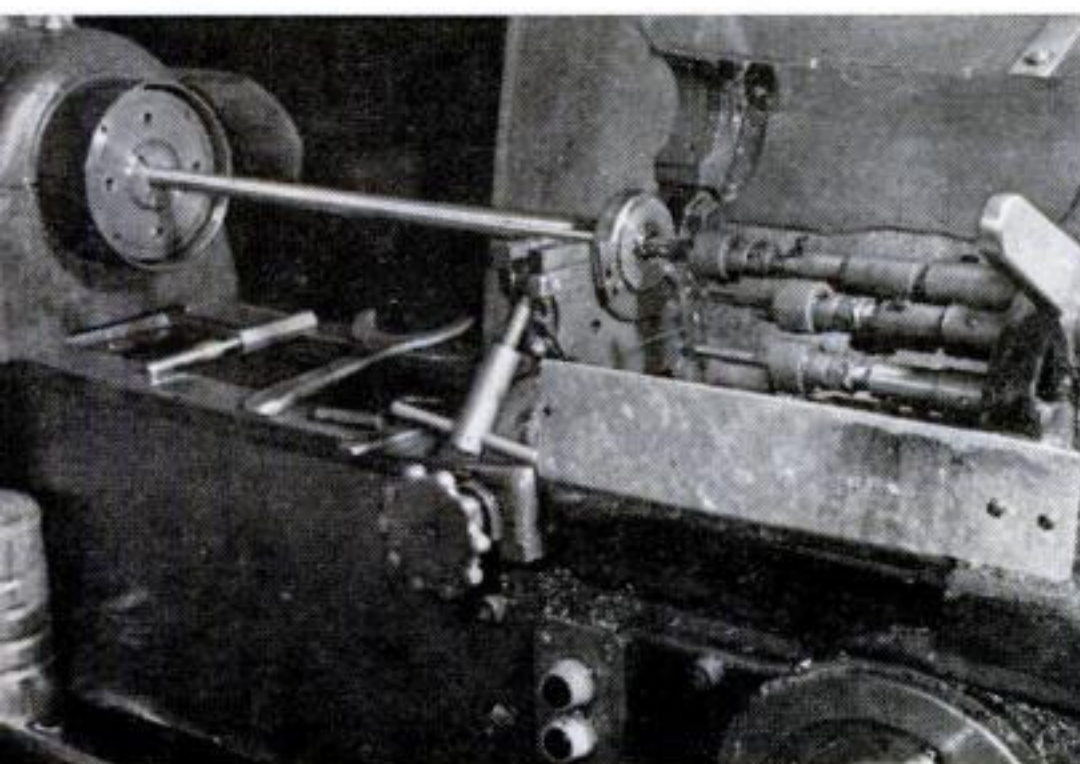


5 POLISHING provides the smooth finish required for bluing. Higher-priced models get an additional buffing treatment.

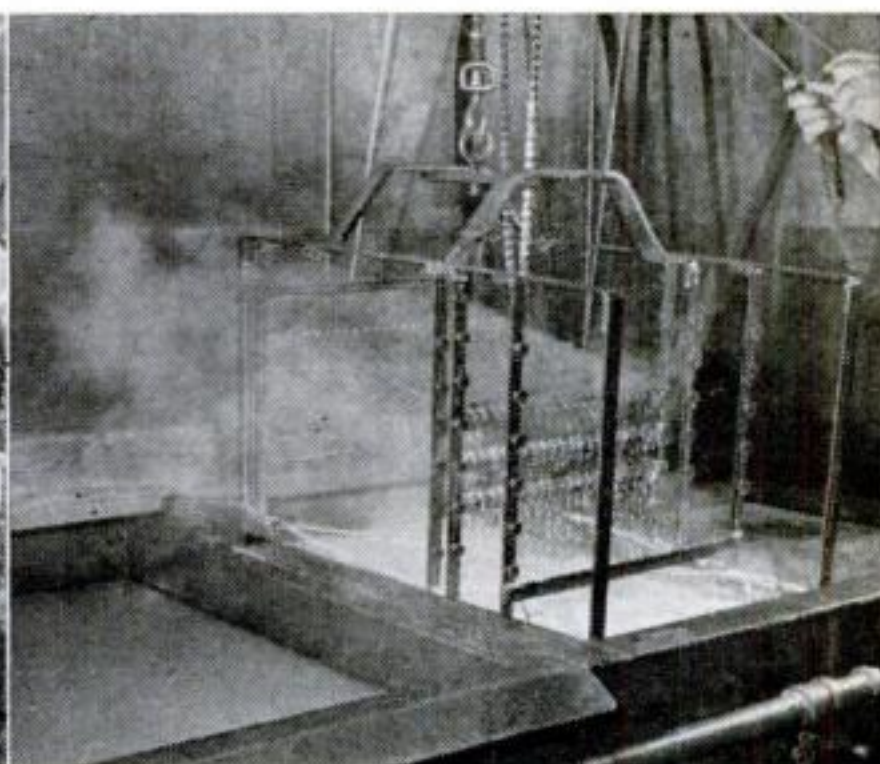


3 AN EAGLE EYE is needed to spot bends in the bore. Knowing where to apply pressure on the hand press is even trickier. Sighting through

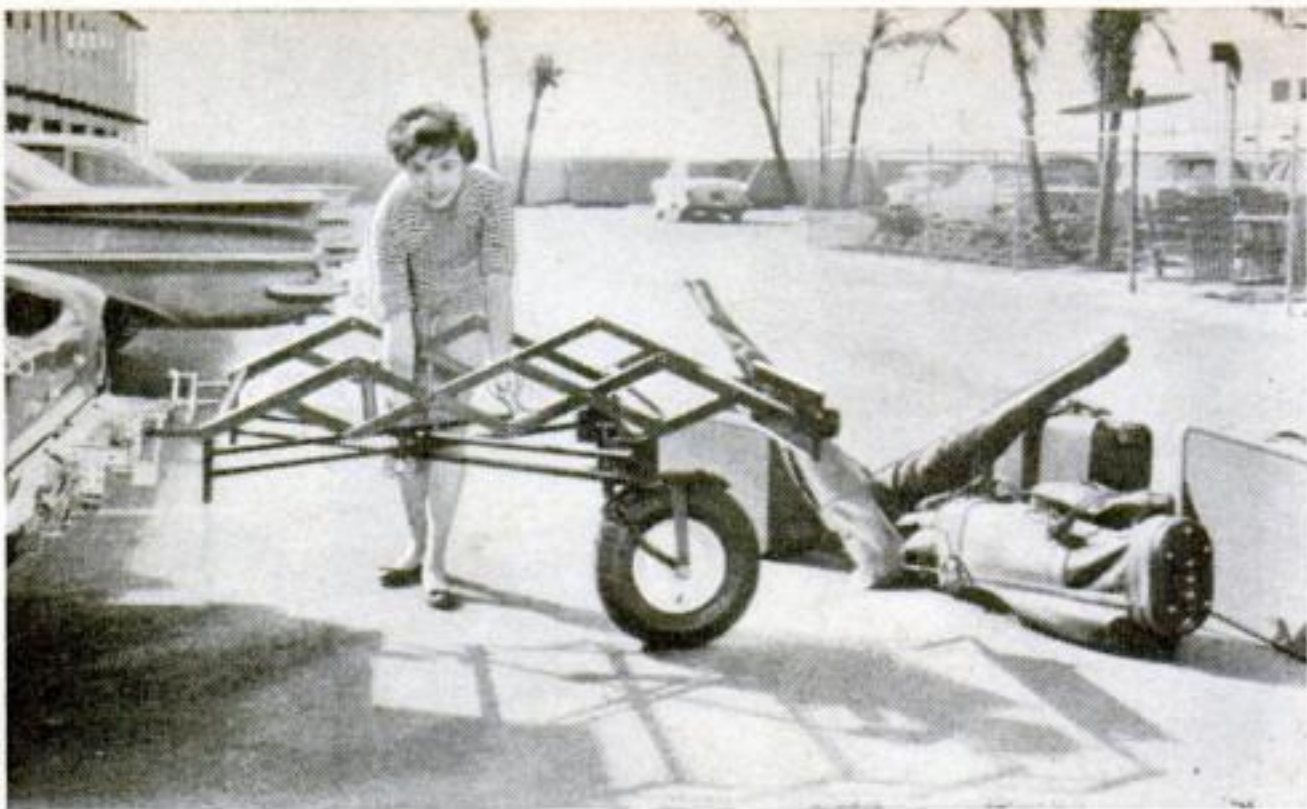
the barrel at a light, the straightener sees two converging, railroad-track-like lines of light. Waves in the lines indicate bends.



6 GAS-TIGHT CHAMBER is cut in one end of the barrel to receive cartridge. Chamber must be perfectly smooth, or shell may freeze.



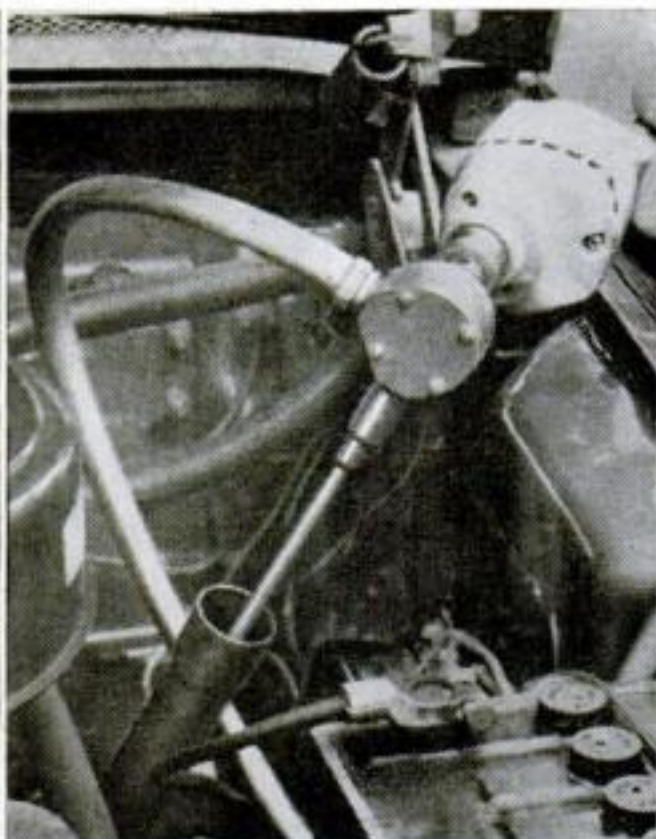
7 CAUSTIC BLUING SALTS protect the steel from corrosion. The barrels are lowered in racks. An oil bath gives added protection.



Folding Trailer Fits Bumper

To put this trailer into service, you attach a swivel-mounted wheel, open the frame like a pair of lazy tongs, bolt it rigid at the corners, and insert metal sides, ends, and floor. When not in use, the rack can be folded almost flat to fit snugly over the rear bumper; the wheel

and other parts store in the trunk. The Fold-N-Roll trailer will hold up to 500 pounds. It comes with a choice of hitches to fit even compacts and small foreign cars. Price, \$199.50; hitch and tarpaulin cover extra. Award Mfg. Co., 660 W. 17th St., Costa Mesa, Calif.



EPOXY VARNISH is said to fuse to wood, sealing out dirt, and leaving a hard surface that resists marring by boiling liquid, alcohol, and hard use. Half pint, 79 cents; pint, \$1.27; quart, \$2.25; gallon, \$7.65. Sapolin Paints, Inc., 205 W. 42nd St., NYC.

PORTABLE PUMP chucks in an electric drill to drain oil, fuel, water, and other liquids. It's made of molded nylon, has a steel shaft. Kit includes one discharge and four intake tubes. \$19.95. Huber Industries, Inc., 4960 Hillside Ave., Cincinnati.

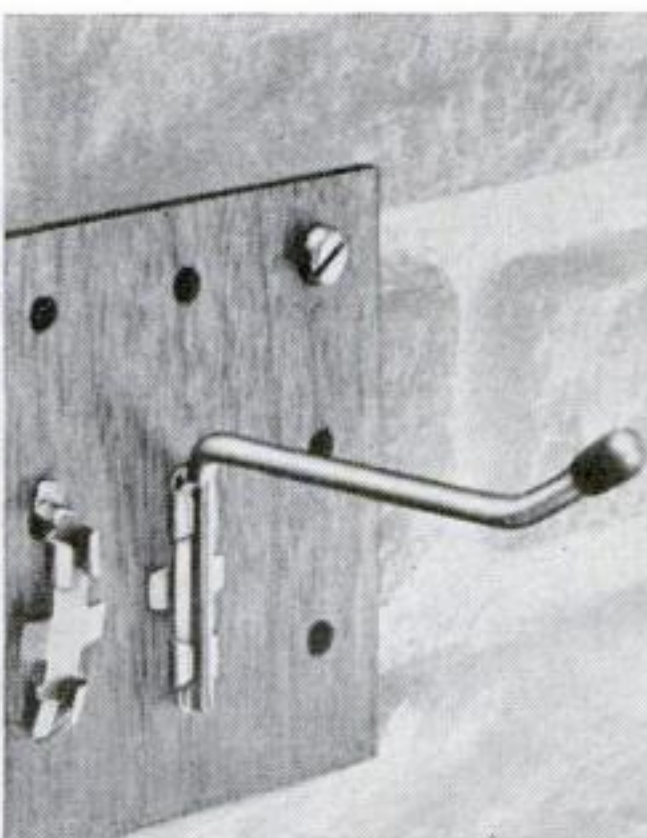
CORDLESS SHAVER has three heads driven by a strong armature-wound motor. Battery-powered Lektronic stores enough energy for three weeks of shaving, can be recharged on 90-to-250-volt AC. \$35.95. Remington Electric Shavers, 60 Main St., Bridgeport, Conn.



MATCHED POWER TOOLS—drill, sander, jigsaw, accessories—have individual motors instead of interchangeable heads. Four-inch leads plug into a 10-foot extension cord. They sell in the \$50 to \$70 range depending on the tools you select. SpeedWay Div.-Thor, 1421 Barnsdale Rd., LaGrange Park, Ill.



LIQUID LOCK holds threads of bolts, nuts, screws, and other fasteners in place like a lock washer. To loosen, you simply put a little extra force on the wrench. A tube of Lock-it costs 69 cents. Woodhill Chemical Corp., 1390 E. 34th St., Cleveland.



PEGBOARD CLIPS let you use a board mounted directly on a wall instead of on furring strips. Flat tabs are pressed into holes with a key or one of the fixtures. Package of clips and fixtures, 39 cents up. Perclip Corp., 158 Eagle Dr., Stamford, Conn.



PLUG CLEANER fits inside spark plug to scrape carbon, lead, and sand from porcelain. You simply insert, twist, and pull. It comes in three sizes for various makes of single-electrode plugs. Price, \$2.40. Emil W. Malchow, 4207 Cortland, Lynwood, Calif.

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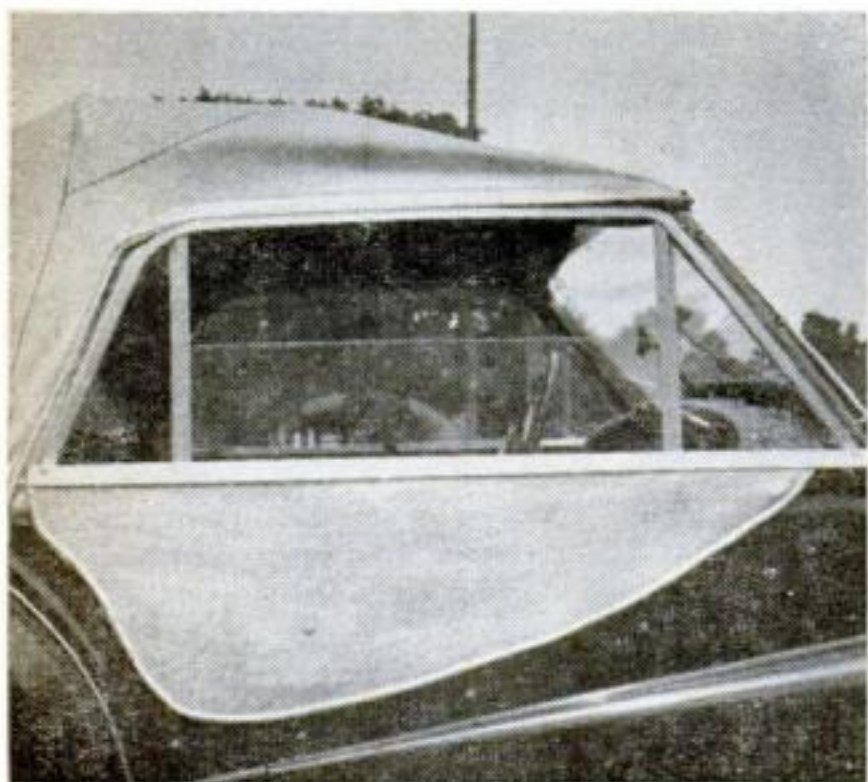
WHAT'S NEW.....



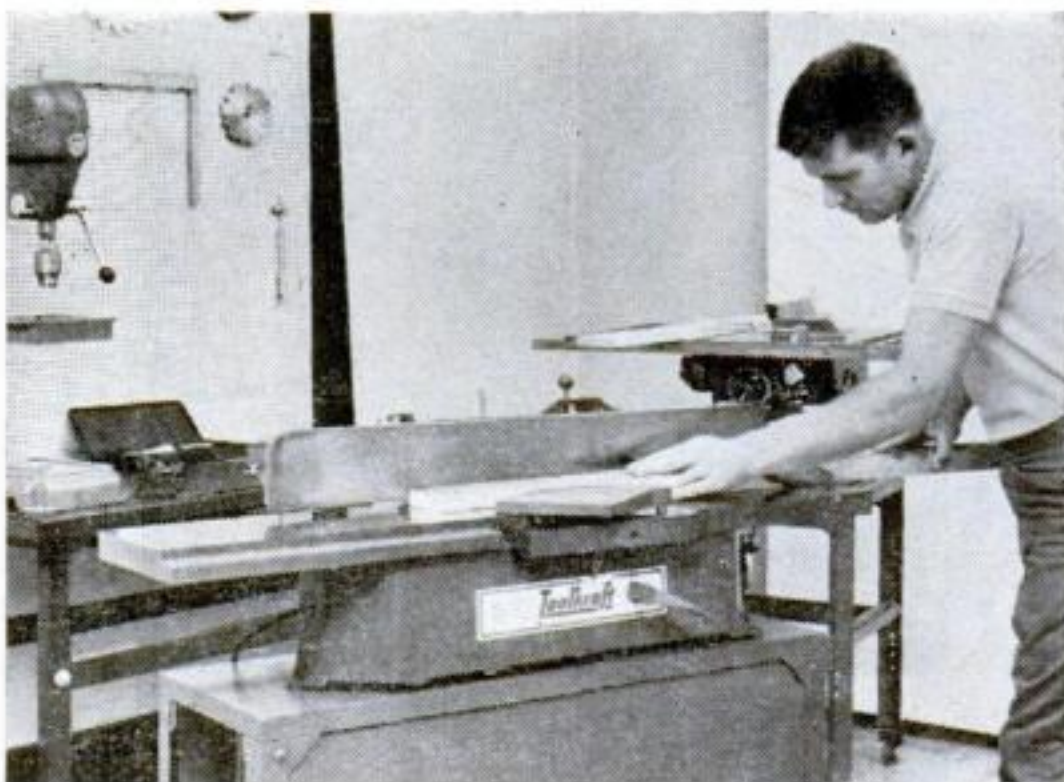
POST PULLER fastens over a tractor drawbar, grips any post up to six inches in diameter, and pulls it out of the ground. One man working with it from the tractor seat can pull 20 to 30 posts an hour. It also uproots brush and small trees. Price, \$42.50. Perma-Weld Co., 1947 N. Topeka Blvd., Topeka, Kan.



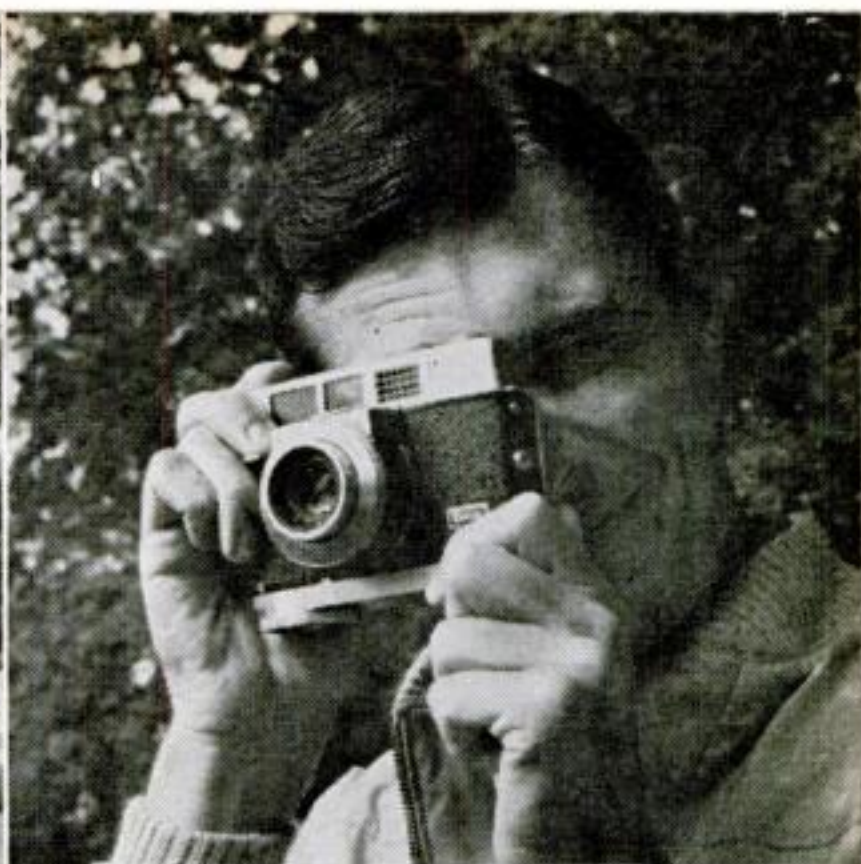
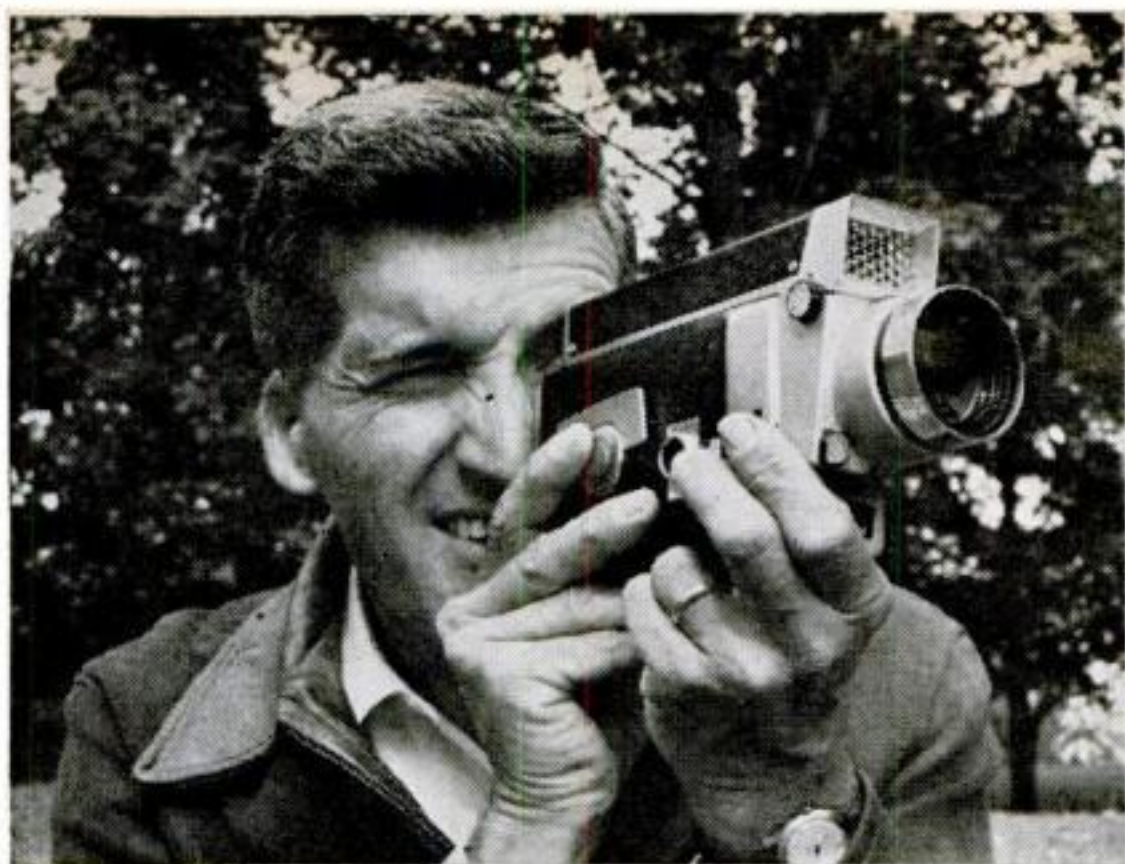
SHOCKPROOF DRILL is doubly insulated in a nonconducting nylon housing to make it safe for use outdoors on damp ground or near water. No grounding is needed; you can plug it into two-prong receptacles without danger. The Safe-T-Drill is \$24.95; attachments extra. Millers Falls Co., Greenfield, Mass.



PULL-UP SIDE WINDOWS fit all Triumph roadsters as replacements for screwed-on original equipment. Channels lock into windshield to keep windows from bowing out at high speed. Center panel slides into aluminum lower section. Pair, \$89.95. Bakers Worldwide Auto Parts, Inc., Box 57, Franklin Square, N. Y.

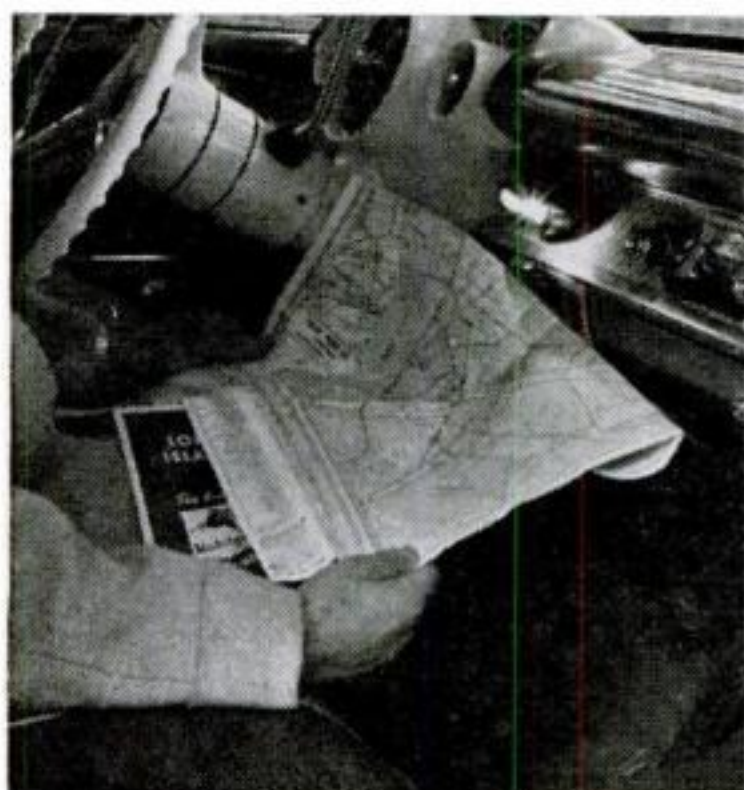
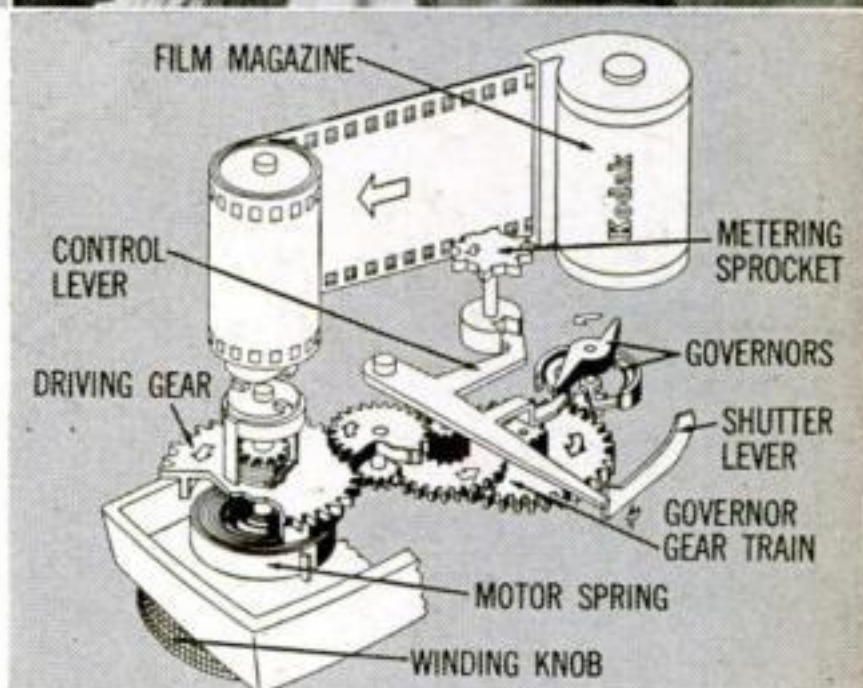


LONG-BED JOINTER has a front table that raises diagonally on parallel linkage to maintain constant $\frac{5}{32}$ -inch distance between edge and cutter knives. Maximum cut is six inches wide and $\frac{1}{2}$ inch deep. A GE $\frac{3}{4}$ -hp. motor is built in. \$179.95. Toolkraft Corp., 700 Plainfield St., Springfield, Mass.

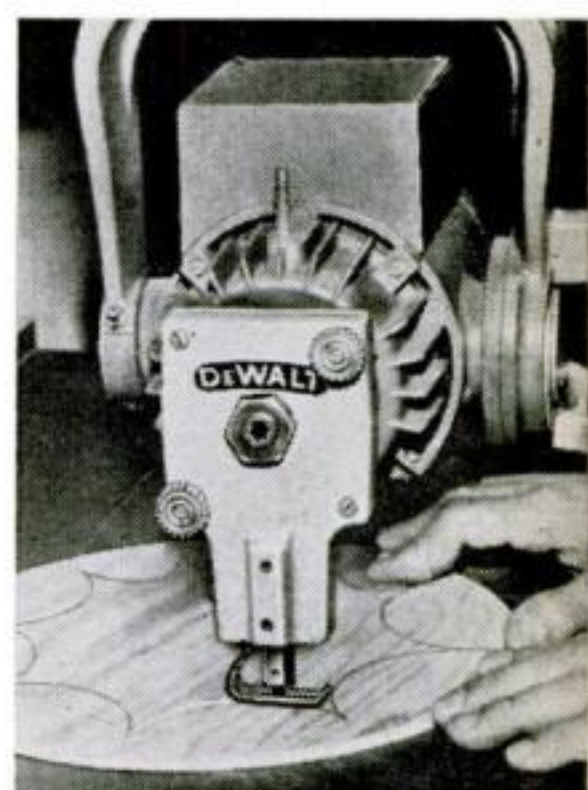


Motorized Kodaks

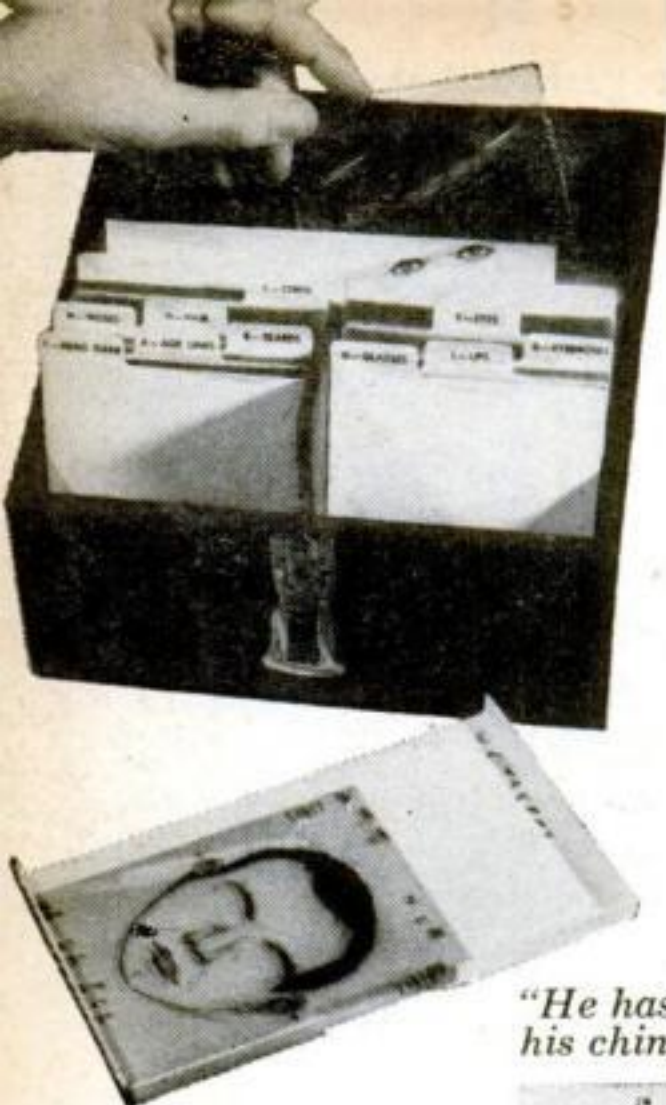
Spring motors operate controls on two new cameras. One on an eight-mm. movie camera moves the zoom lens smoothly between wide-angle and telephoto shots. The camera also has automatic and manual exposure, and a reflex finder that eliminates parallax. A motor in a 35-mm. Retina camera advances film automatically when the shutter is clicked. Movie camera, \$189.50; still, \$109.50. Eastman Kodak Co., 343 State St., Rochester, N. Y.



DASHBOARD SPOTLIGHT is a shielded lamp that you plug into the cigarette-lighter socket of any 12-volt car. It can be turned at an angle to direct below-eye-level light on a road map, keys, cash, memorandums, or to the floor to help find dropped articles. A permanent magnet parks it near the socket when it's not in use. Pathfinder Dash Light sells for \$1. Auto Lamp Mfg. Co., 2909 S. Indiana Ave., Chicago.



SABER SAW can be used on radial-arm wood- and metal-cutting tools with this attachment. It lets you do curved work at any angle on stock up to two inches thick. \$14.95. DeWalt, Inc., Lancaster, Pa.



Jigsaw Puzzle Helps Catch Crooks

A boxful of transparent slides, each bearing a facial characteristic, is the latest weapon in the war against crime

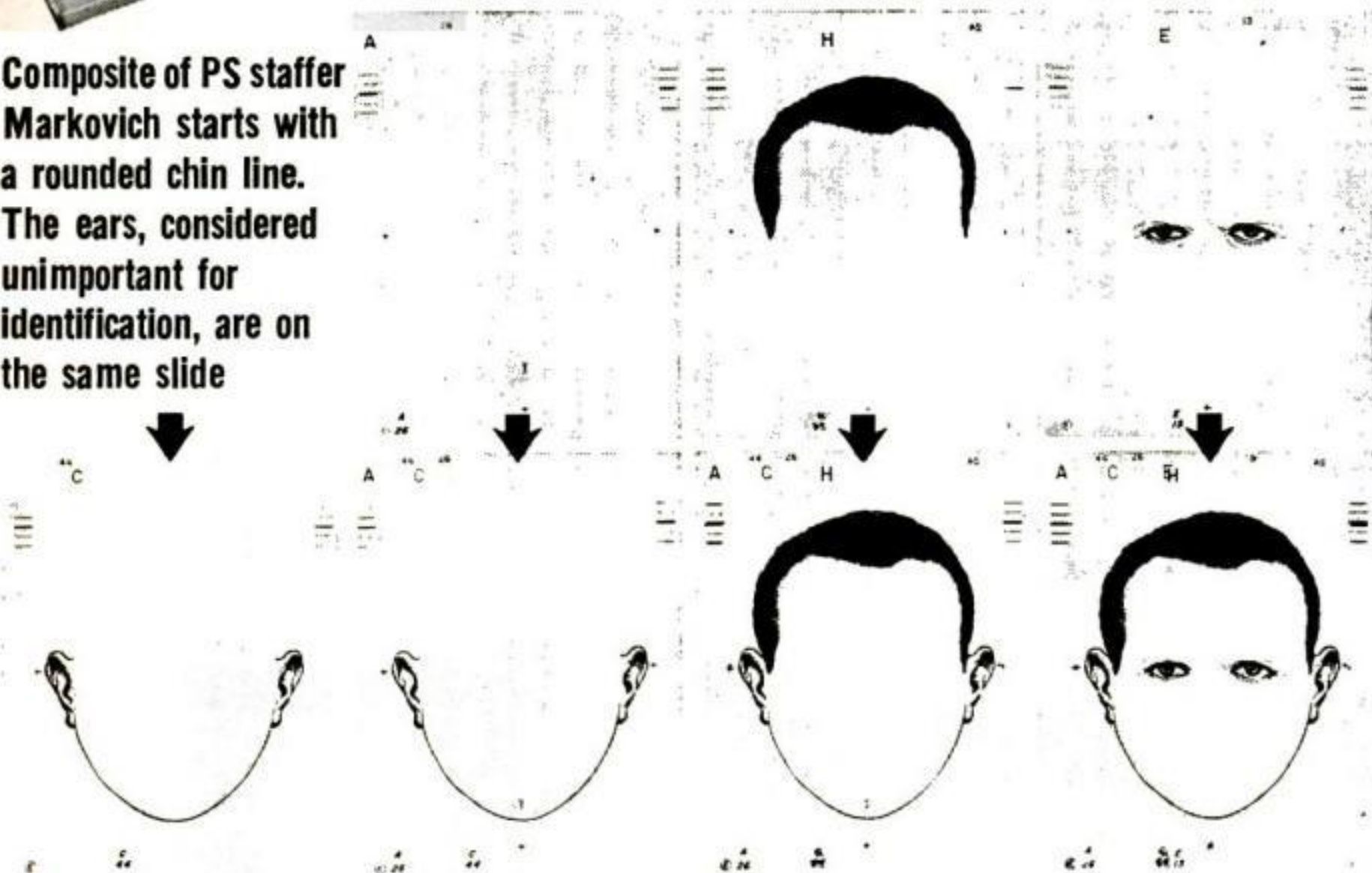
By Alex Markovich

"He has a cleft in his chin..."

"...and his hairline is receding."

"The eyes are almond shaped."

Composite of PS staffer Markovich starts with a rounded chin line. The ears, considered unimportant for identification, are on the same slide



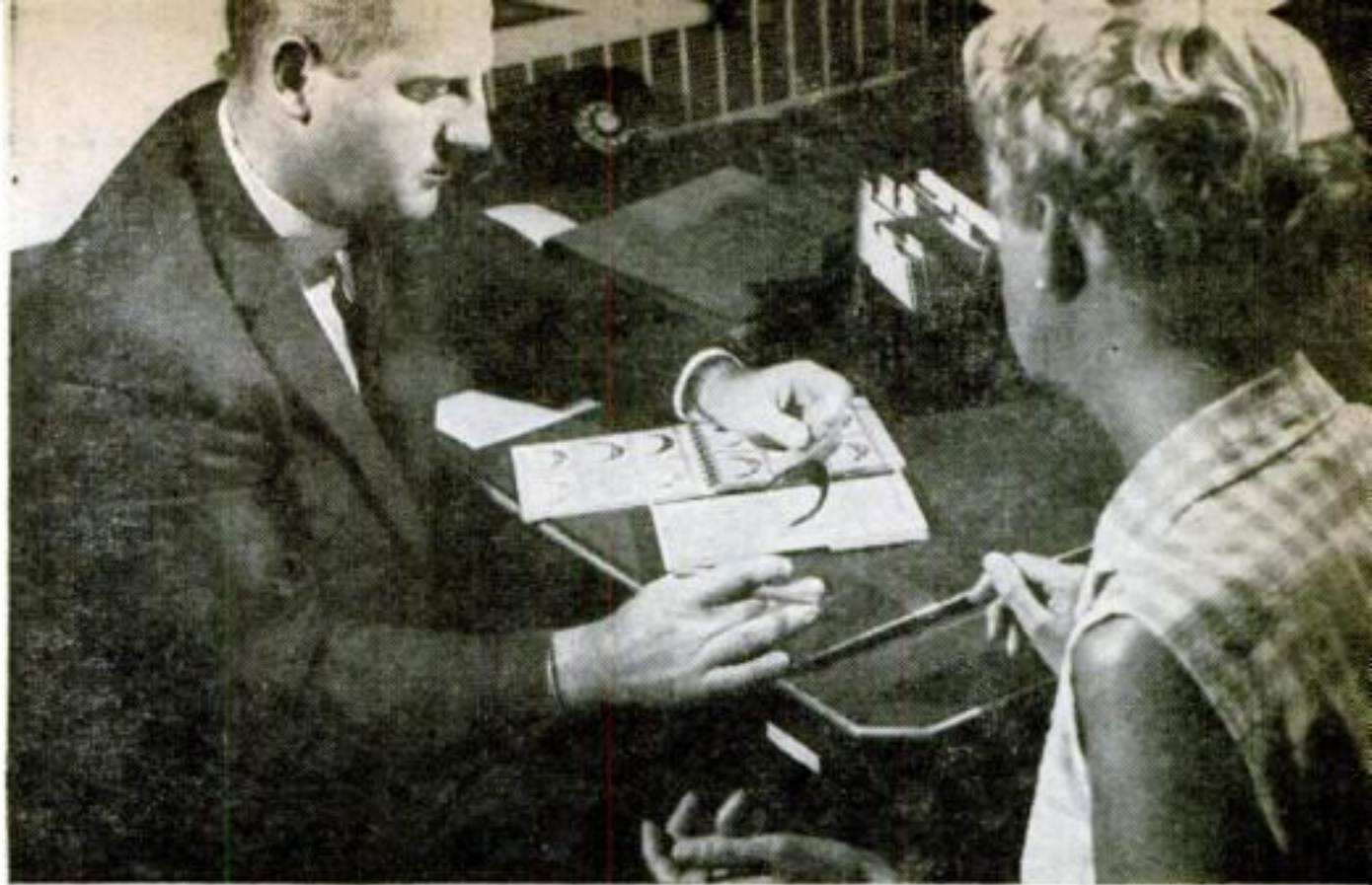
THE police secretary studied my face intently for a minute. Then she sat down beside a detective and began describing my features. The detective took notes and occasionally pulled a transparent slide of a facial feature—a nose, mouth, chin line, set of eyes—from a small box.

Within minutes, by overlaying the slides he constructed a composite picture: a remarkable likeness of me!

The little brown box. This revolutionary identification system—Identi-Kit—provides police with over 500 numbered slides in a walnut file. With it, police can assemble 62 billion combinations of facial characteristics, enough to recreate the likeness of any male adult in the world.

The kit will turn out a picture far faster, and often more accurately, than a police artist can draw it. Code numbers on the slides can be broadcast or

THE WITNESS, Police Secretary Eve Willmott, describes "criminal" to Detective William Trefny of Greenwich, Conn., Police Department. After taking notes, Detective Trefny plucks appropriate hairline from the file. Completed composite is shown to witness, who may suggest changes. Identicops must undergo 40 hours of specialized training. Trickiest phase: learning to question witnesses effectively.

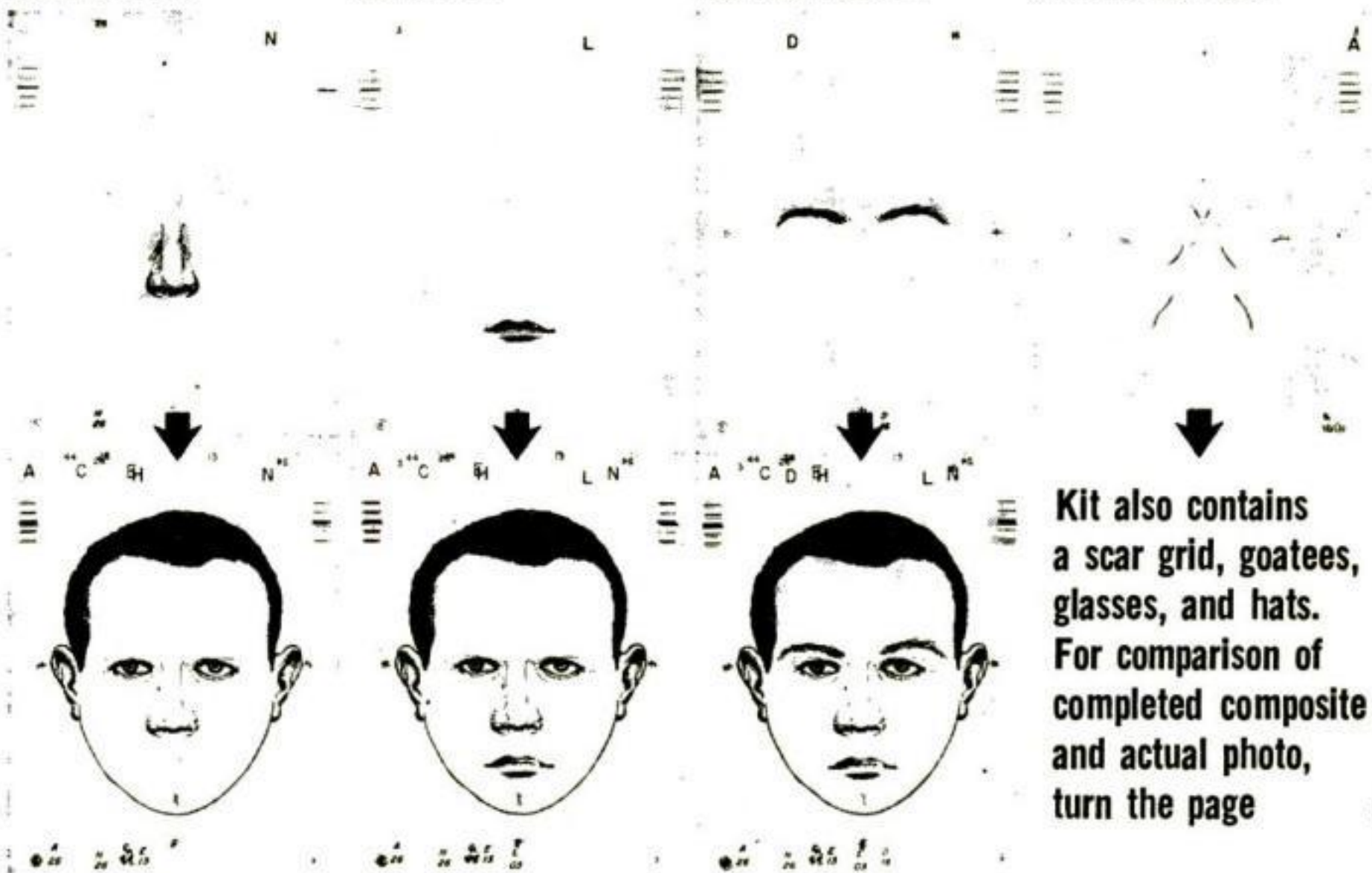


"A straight, short nose, and ..."

"... he has a straight lip line ..."

"Eyebrows heavy near his nose ..."

"... and caliper lines around the nose."



Kit also contains a scar grid, goatees, glasses, and hats. For comparison of completed composite and actual photo, turn the page



telegraphed to other police departments so that they can put together an identical picture in a few seconds.

Bits and pieces nab bandits. One of the many police cases in which the kit played a vital role was a recent payroll robbery in Los Angeles. The man was caught within two hours of the crime when an Identikit picture helped police find his mug shot. In San Bernardino, Calif., a policeman assembled a composite of a

holdup man and recalled seeing the man earlier at a nearby gas station. A stake-out netted the subject—and five members of a stolen-car ring as well.

It cost over \$87,000 to develop the Identikit. Manufactured by the Townsend Co., Santa Ana, Calif., it already is in use by 45 police departments throughout the continental U. S., as well as in San Juan, Puerto Rico; Tel Aviv, Israel; and Port-au-Prince, Haiti.

Here's Identikit picture and "mug shot" (previous page). Code numbers are at bottom of composite. If you see this man, don't call police; he is unarmed and harmless



Sea cycle

Latest fad at Japanese resorts is sea cycling. The cycles are built of two pontoons connected by a platform on which an outboard motor is mounted. The one at left is steered by bicycle handlebars. Its five-hp. motor will make it go $12\frac{1}{2}$ m.p.h.; others with larger engines do up to 50 m.p.h.



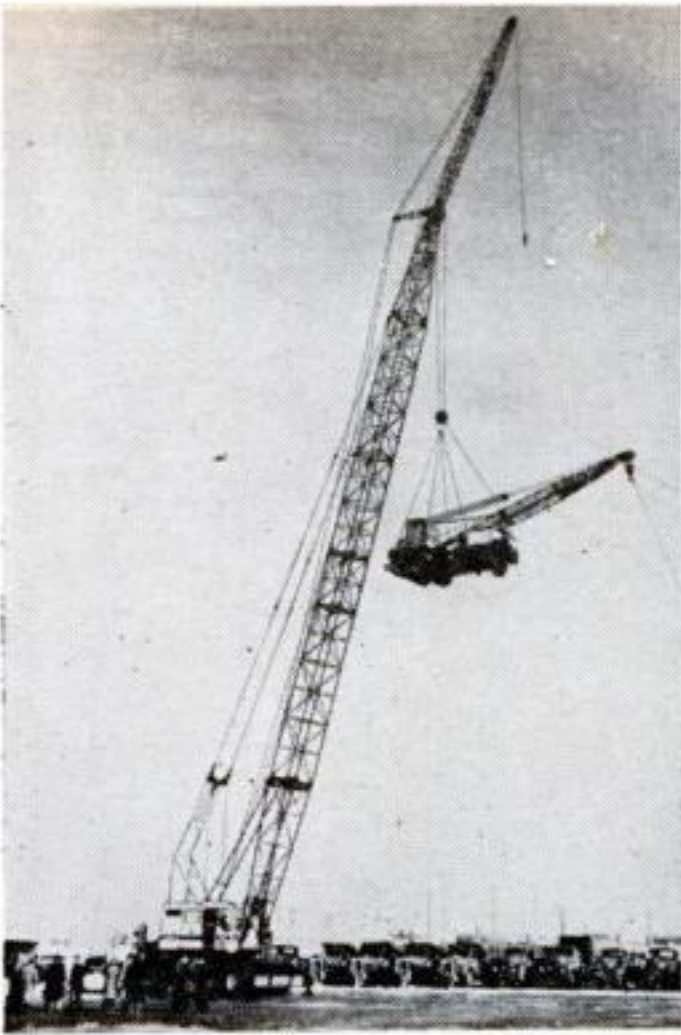
Air-cooled paddy wagon

Considerate police in Philadelphia have fitted the rear windows of their fleet of patrol wagons with modern jalousies. They provide maximum ventilation for prisoners being transported to jail and still allow little margin for escape.



Anti-static tinsel

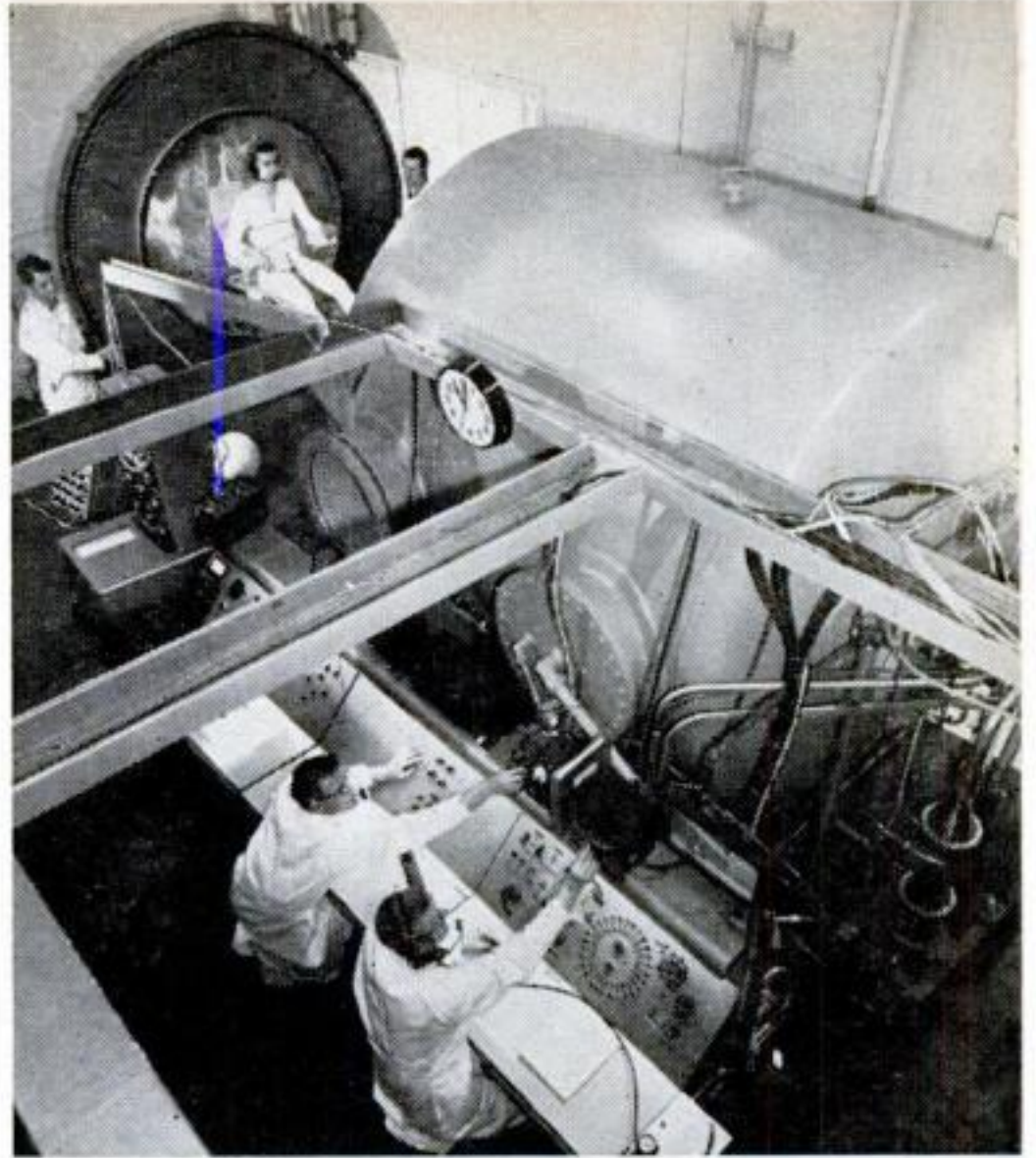
Christmas-tree tinsel finds year-round use in Admiral's TV-cabinet plant at Shelbyville, Ind. Grounded and hung to drag over lacquered cabinets as they move on an assembly line, it removes static electricity, keeps dust from collecting.



Big crane lifts little one

The world's largest truck-mounted crane above hoists its 31,000-pound "little brother" 90 feet without effort. The P.&H. monster is equipped with a 200-foot main boom and a 50-foot extension. It can lift 80 tons.

The Miti-Mite getting a ride has a 70-foot boom and 20-foot extension, can handle 25,000 pounds. Both are made by Harnischfeger Corp., Milwaukee.



Taking a trip into space

Future astronauts will experience the six known hazards of space travel in this multi-stress chamber now nearing completion.

Boeing engineers designed it to test tolerance of both humans and equipment to simultaneous noise, intense light, vibration, and variations in pressure, temperature, and gas. The "pilot" would perform normal functions during the experiment.



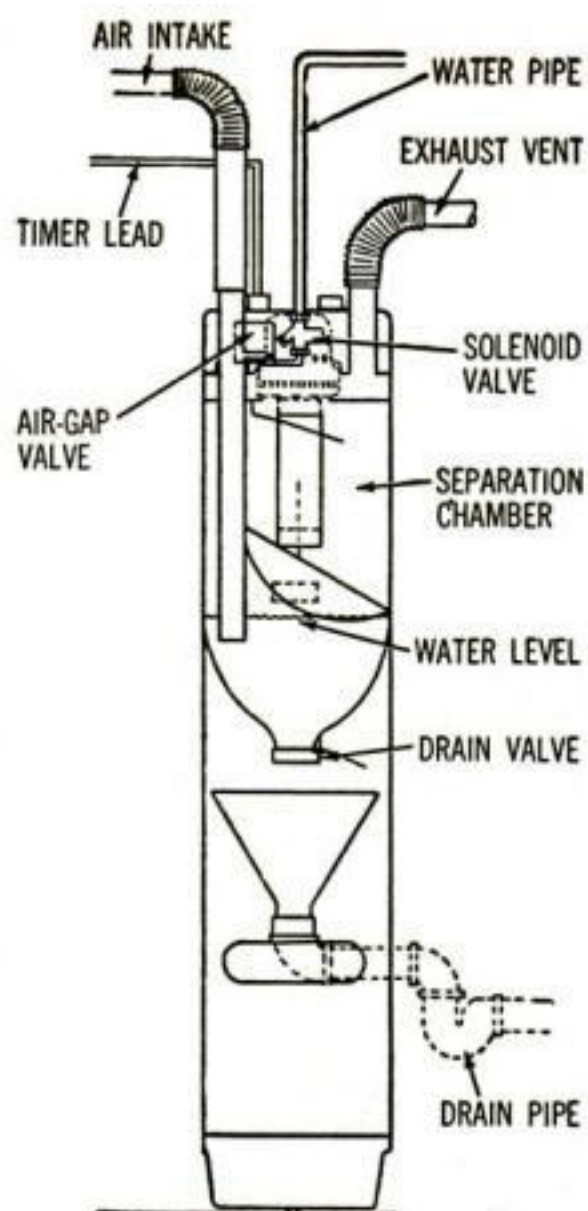
Truck gets extra power from trolley line

This huge dump truck rides on tires 4 feet wide and $7\frac{2}{3}$ feet high. The floor of its high cab is 12 feet off the ground. Drawing current from overhead trolleys, it develops 1,600 hp. to run motors in each of its four wheels, and will

haul 60-ton loads up a seven-percent grade. A diesel-electric generator furnishes 335 hp. for operating away from trolley wires. R. G. LeTourneau built it for testing by the Anaconda Co. at its open-pit copper mine near Butte, Mont.



LIKE A CAT LAPPING CREAM: Up goes dirty scrub water or spilled liquids. The cleaner also washes windows and tile walls.



TURN ON THE MOTOR and the solenoid valve measures about $2\frac{1}{4}$ gallons of water into the separation chamber. Dusty air passes through intake into the water; filtered air exits through exhaust vent. When motor is shut off, the drain valve opens, allowing water to flow into drain cone and out the drain pipe. Remote-control timer regulates operation of motor. Air-gap valve prevents dirty water from backing up and contaminating the water pipe.

Built-in Vacuum Washes Away Dirt

THE next house you buy may be equipped with a brand-new appliance—a revolutionary vacuum cleaner that flushes dust and dirt down the drain. Or, if you're impatient and don't mind doing some replastering, you can install the device in your present home.

The Aquamatic is built into the walls, like plumbing or electrical wiring. Concealed pipes lead from wall valves in each room to a single power unit permanently positioned in basement or utility room. Flexible vinyl elbow tubing eases installation. A 25-foot hose with a cleaning attachment and sponge plugs into one

of the conveniently located wall valves.

Dust-laden air passes through the pipes into the power unit, where it is filtered by water. The "washed" air is vented out, while dirt remains in the water. A few of the cleaner's advantages:

- No bags or filters to empty.
- No recirculation of dust; air is exhausted outdoors.
- No heavy portable power unit to drag from room to room.
- No noise; the power unit is stored away from living areas.

It's made by My Maid Corp., Fort Atkinson, Wis. Cost: \$375.



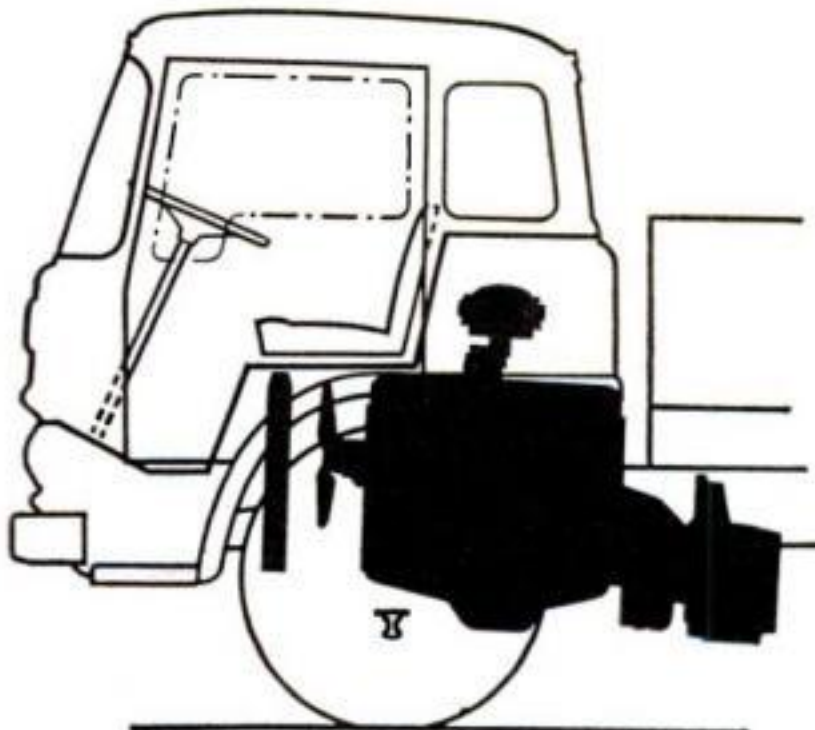
There's no place like a homey foxhole

Future GI's may find it a pleasure to crawl into a foxhole like the one above at right: no mud, no water, no dirt—unlike the familiar one at left. It's sprayed

with waterproof urethane plastic foam from a portable field unit. Both are made by Freedlander Research and Development Laboratories, Hawthorne, Calif.

Easy-to-service truck

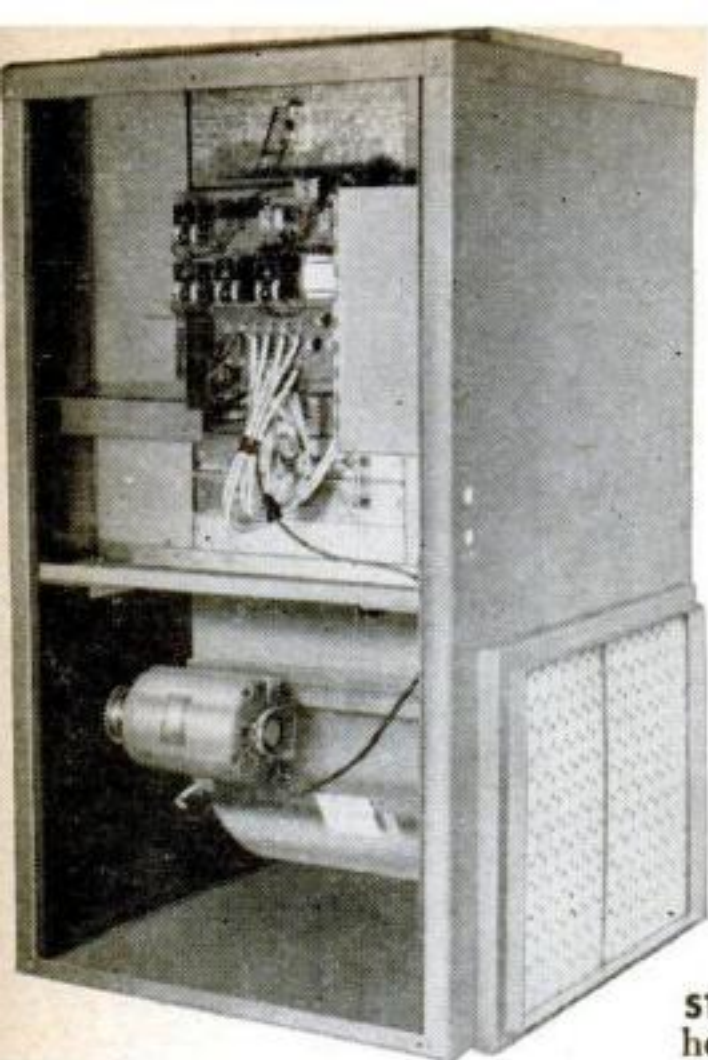
A new cab-before-engine Bedford truck has its power plant mounted behind the front axle. It's reached for servicing through hinged side panels. As a result of the design, the three-man cab has a step only 19 inches high, a flat walk-through floor, is cooler and quieter. The truck is made in Britain by GM in models that carry 4 to 12 tons.



Engine is mounted behind the front axle.



Hinged door keeps mechanic out of traffic.



No Flame, No Smoke, No Chimney

Hottest news in heating is electricity. It's not cheap, but it's good. And there are new tricks in oil and gas heat, too

STAGNANT WARM AIR, a problem with early electric heating systems, is eliminated by electric furnaces.

By David X. Manners

BIG new advances are at hand on several fronts in home heating. Most exciting is the great surge toward electricity. The good news: Flameless, smokeless, chimneyless electric heating is now practical in almost any climate, and at a price within reason.

The secret of electricity's new success is threefold. First is the improved method of building houses that are to use it. They are so swaddled in insulation that heat has almost no way to escape. The result: Even though electric rates haven't come down, the cost of electric heat has.

Debut of the electric furnace. This new automatic wonder adds its bit. It does things electric heat has never been able to do before. It circulates, filters,

humidifies (or dehumidifies) air, and is easily adaptable to cooling. It also lowers operating costs. By moving air, it prevents heat from stagnating at the ceiling and getting soaked up there without doing any good—a fault with many previous electric systems.

Finally, utility companies once bent on discouraging use of electricity for heating are now plugging it for all they're worth. They'll even pay builders to install it. They need the winter business to help balance their summer air-conditioning load. Heating uses plenty of electricity: It operates on nearly twice the current of an electric range, and requires at least a 200-ampere service.

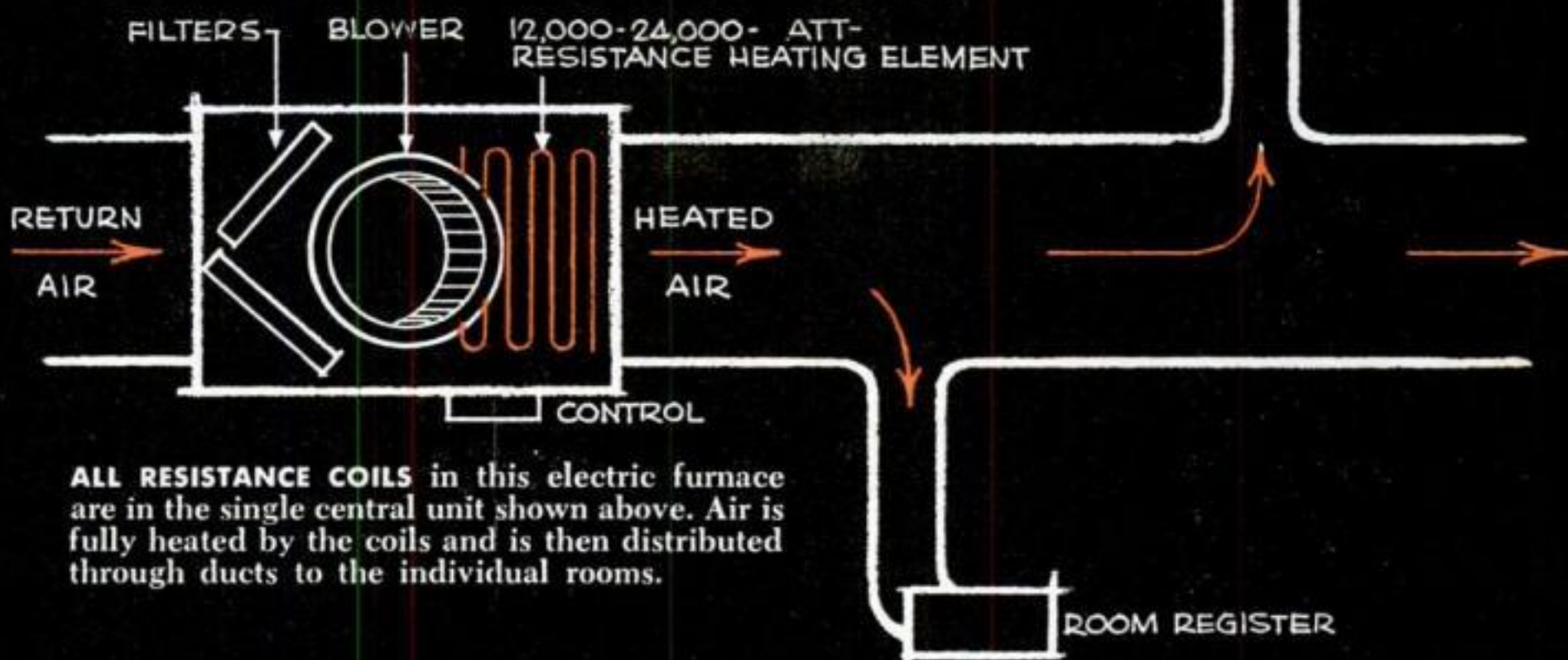
Is it really good? The utility people will tell you that electric heating, needing no combustion air, can be put any-

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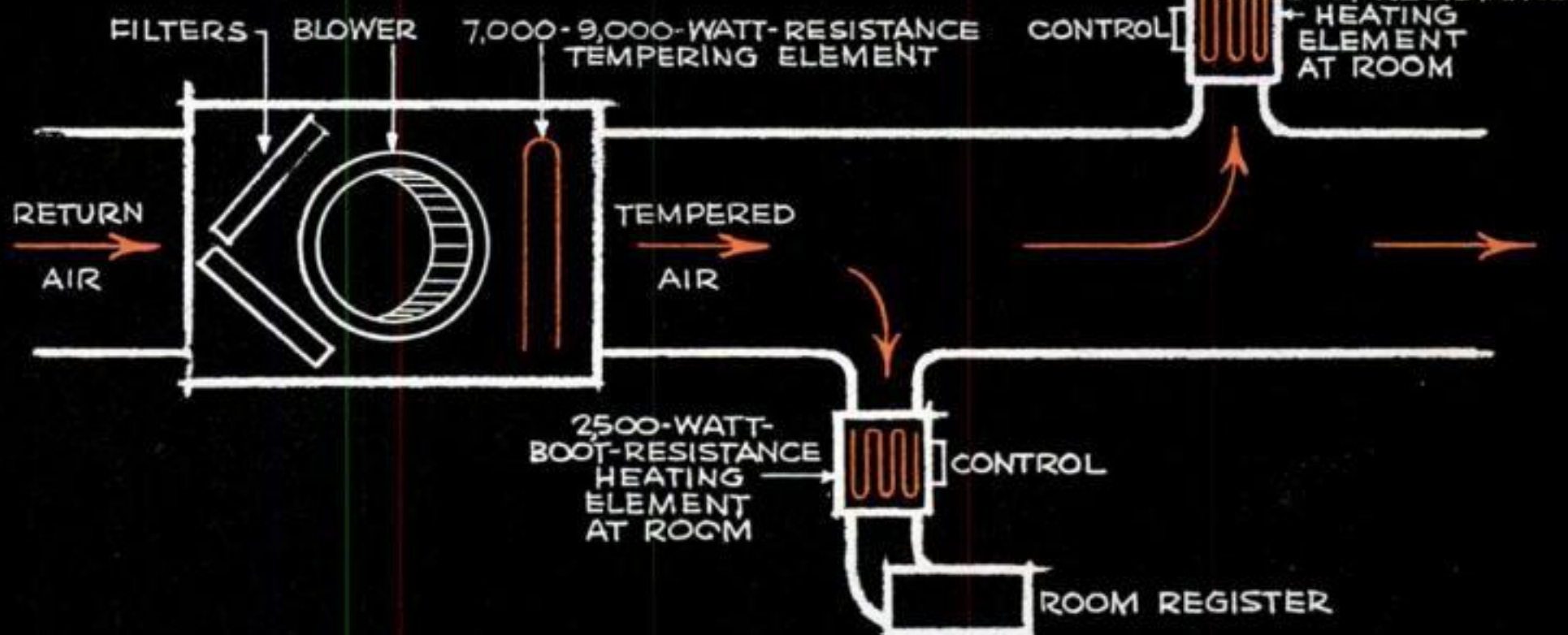
HEAT PUMP can be teamed with electric furnace for economical operation. Pump provides low-cost heat to 40 degrees; below this, resistance coils take over. Lower cabinet section holds blower, middle section contains heat pump. Resistance coils are at the top.

Two systems of ducted electric heat

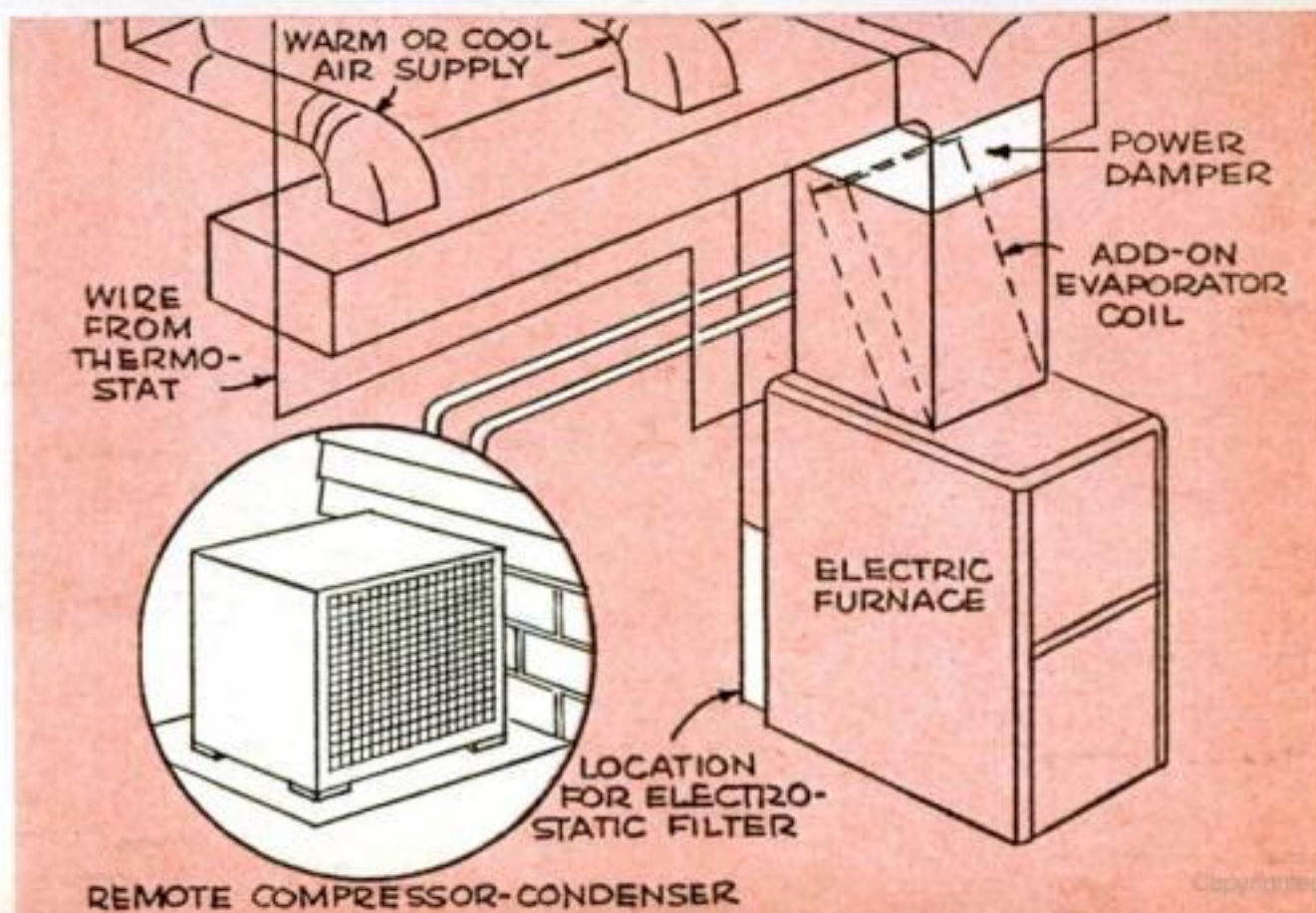


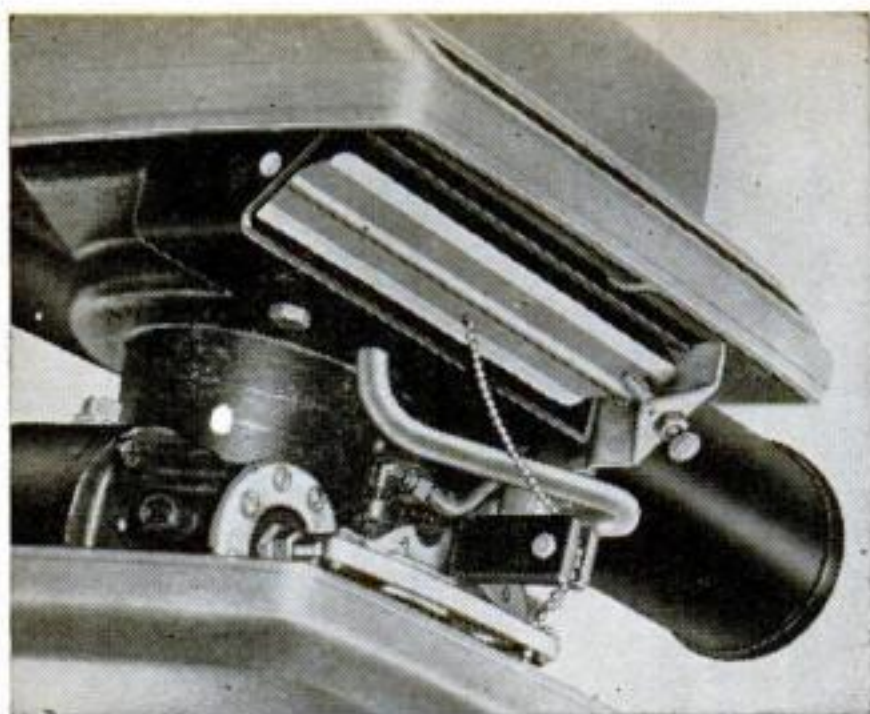
ALL RESISTANCE COILS in this electric furnace are in the single central unit shown above. Air is fully heated by the coils and is then distributed through ducts to the individual rooms.

CENTRAL UNIT here heats the air only partially. Tempered air passes into each room, where individually controlled register-boot heaters or in-duct heaters complete the job.



COOLING SECTIONS, or electrostatic filters, are easily added to electric furnaces. The filter's ionized plates reduce housecleaning by stopping up to 90 percent of all airborne dust, smoke, bacteria, pollen. Thermostatically controlled damper provides accurate zone control.





SPRING-LOADED DAMPER on this Winkler oil burner closes the air intake when the burner is off, preventing heat loss of about 5,000 BTU per hour. Available for conversion jobs, the burner can save over \$50 worth of oil in a year.



GALLON OF WATER per room must be added to heated air in winter to maintain 35-percent relative humidity, considered best for health and comfort. This Walton Laboratories forced humidifier is attached to the return-air duct.



LIGHTWEIGHT MATTING of fibrous silica and alumina is said to make refractory brick obsolete for furnace and boiler lining. It reaches incandescence immediately. Installation takes half an hour. Johns-Manville makes it.

where; that it's safer, quieter, cleaner, works well with air conditioning, and makes individual-room temperature control simple. Besides that, its first cost is likely to be lower; it has no moving parts, it's trouble free, and its heating elements should outlast the house.

They frankly admit it's more expensive, just as an electric dryer costs more than a clothesline, but they say it's worth it. Electricity is not being promoted as something cheaper, but as something better.

With the pros go cons. The oil and gas people have a different view of it. The fact that electricity heats without flame, they'll tell you, doesn't necessarily make it safer. Electricity is a principal cause of home fires, and electric baseboards at 325 degrees F. may be dangerously hot. As for cleanliness, the high temperatures of some radiant systems cause serious dust-streaking of walls and ceilings. Further, these systems don't clean the air or remove its odors; in a tight house, last week's cabbage can be with you this week and next.

Sure, they continue, the idea of room-by-room temperature control is appealing, but do you need it? Would you use it? To get the full benefit of room-by-room control you might have to keep all doors closed. Consider, too, that most electric systems operate with line-voltage thermostats. They are accurate only to within three degrees, as compared with the half-degree accuracy of low-voltage thermostats used with other heating systems. When you set the temperature at 72, you don't want it at 69.

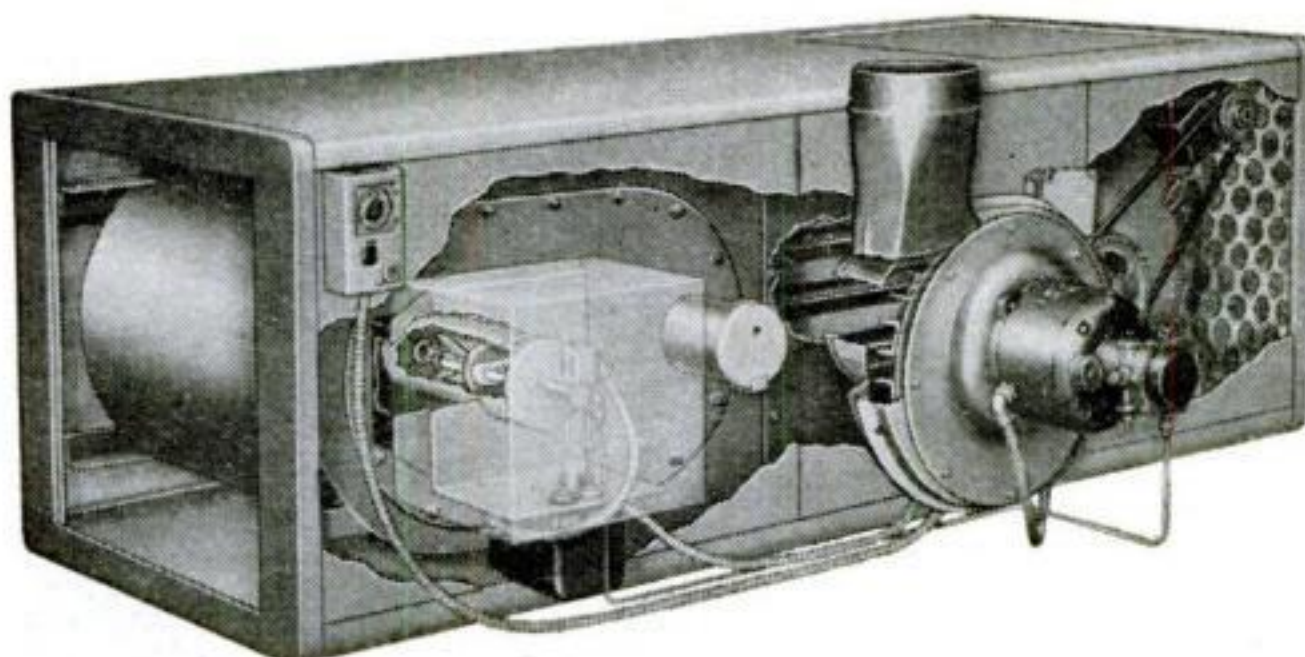
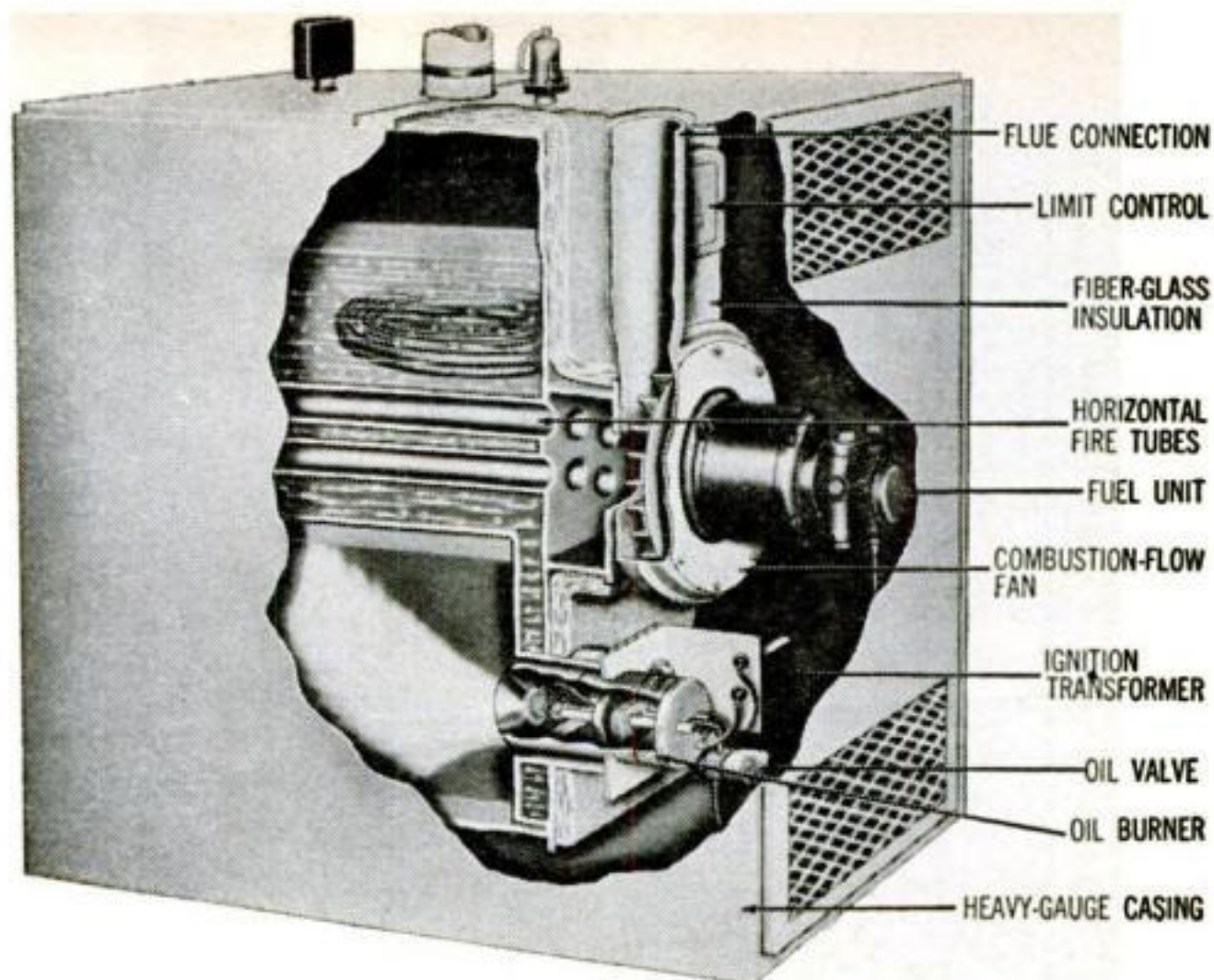
And if you want to know why electric heat isn't "as quiet as a light bulb," they can tell you that, too.

Whatever the pros and cons, every year since 1955 electric heating has grown by 50 percent. This year 150,000 new homes will get it. By 1962 it is expected to account for 15 percent of all new installations. It's plainly here to stay; perhaps eventually it will take over.

What electric systems cost. Electricity heats either by radiation or by warm air. The lowest-priced radiant system employs a grid of resistance cable embedded in the ceiling, and costs about 50-55 cents per square foot of living area. The trend, however, is toward baseboard radiant heaters. They cost about 65-75 cents a

Electric furnaces circulate, filter, humidify

HOT WATER, TOO: All-copper hot-water coils that supply plenty of clean, low-cost hot water without a separate heater are optional in the Iron Fireman boiler (shown in cutaway). Two-temperature hot water is available if desired; such a unit provides hotter water for kitchen and laundry.



COMPACT DESIGN of Iron Fireman horizontal electric furnace allows mounting in a crawl space beneath the floor, in a utility room or attic. If unit is located in attic, outdoor vent can be concealed by prefabricated chimney. Fresh air drawn by furnace allows use of fireplace without open window.

square foot, but are cheaper to operate.

Other radiant types include individual wall or ceiling units (like those in a bathroom), and drop-in heaters that fit in the floor like registers. These run about 75-85 cents per square foot of living area. Hot-water electric systems at 80 cents to \$1.20 per square foot are the most expensive of the radiant types.

By eliminating the need for a central heating plant, all radiant systems save about 15 square feet of space (at \$10-15 a foot), plus a chimney (at \$80-100), and all ductwork. If you have the current to spare, a radiant system is the simple solution for heating an addition to your home.

Warm-air systems require ducts and

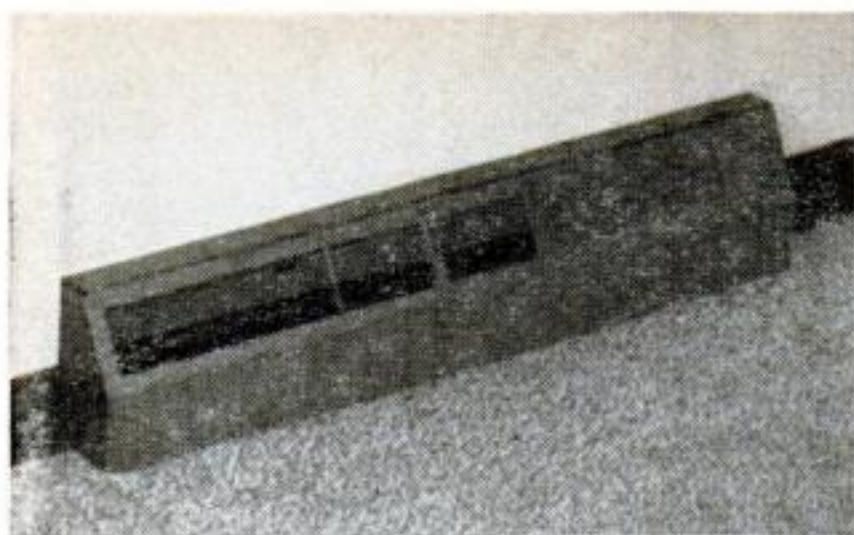
Soon You'll Be Seeing

- Heating equipment located outdoors. It will save room, be safer and handier for servicing, and offer less of a noise problem. The cost of a vent will be eliminated.

- One centralized oil tank for a block of homes. It will reduce distribution costs. The oil company will own the installation,

and meters will tell how much each home is using.

- Oil-fired heating plants leased by dealers. You'll no longer buy your own, and service will be free. Dealers are already using this system, and like it, for it protects them against loss of accounts. With no investment to make, customers are expected to like it, too.



THERMOSTATIC DIFFUSERS such as this Room-Temp unit, added to any perimeter heating or cooling system, provide individual-room temperature control, reduce power consumption.

space for a furnace, but they still are relatively inexpensive. A good system for a typical house of 1,200 square feet may cost as little as \$600. That's about the same as gas, and less than oil equipment.

My Most Embarrassing Shop Moment

"BILL'S working in his garage," I said as we drove up. "He's all thumbs. I better see whether he's headed for trouble."

"Come in the house soon," responded my wife. "I want you to show Ellen the scarf I knitted for you."

New to power tools, Bill was trying to clean the rust off a coaster wagon with a rotary wire brush in his new electric drill. Just as I came up, the whirling brush skittered off a rounded edge.

"Here, give me that!" I said. "It takes a firm hand. I'll show you."

To stoop more easily, I opened my coat. Knowing how tricky rotary brushes can be, I held back firmly. In fact, I yanked the brush off backwards, but shut it off before it touched my chest.

"You've got to keep a finger on that switch all the time," I explained.

Turning on the drill again, I bore down hard on the rust, but was amazed to see a blue fuzz grow on the whirling brush. Only when a feather touch rippled up my chest did I realize what it was.

"We've come to get you two," said Bill's wife in the stone-dead silence that followed my shutting off the drill. "I want to take

Operating costs are about the same as for electric baseboards.

Because of heavy insulation and lowered heat requirements, a typical house designed for electric heating can be served adequately by a 40,000-BTU furnace. The biggest electric furnaces made aren't much over 90,000 BTU. If a house is to be cooled as well as heated, a furnace should be paired with a heat pump. The pump not only provides the cooling, but offers the most economical heat down to 40 degrees F. Below that, the furnace takes over.

Some electric furnaces have all their resistance coils in a central unit. Others have only a tempering coil and blower there; separate heating coils are in a boot just before each room register, making room-by-room thermostatic control easy.

[Continued on page 224]



a look at that scarf she knitted for you."

I pointed dumbly to the wire wheel, huge with unraveled yarn. Of the scarf my wife had knitted, less than half remained around my neck.—H. L. Waldron, NYC.

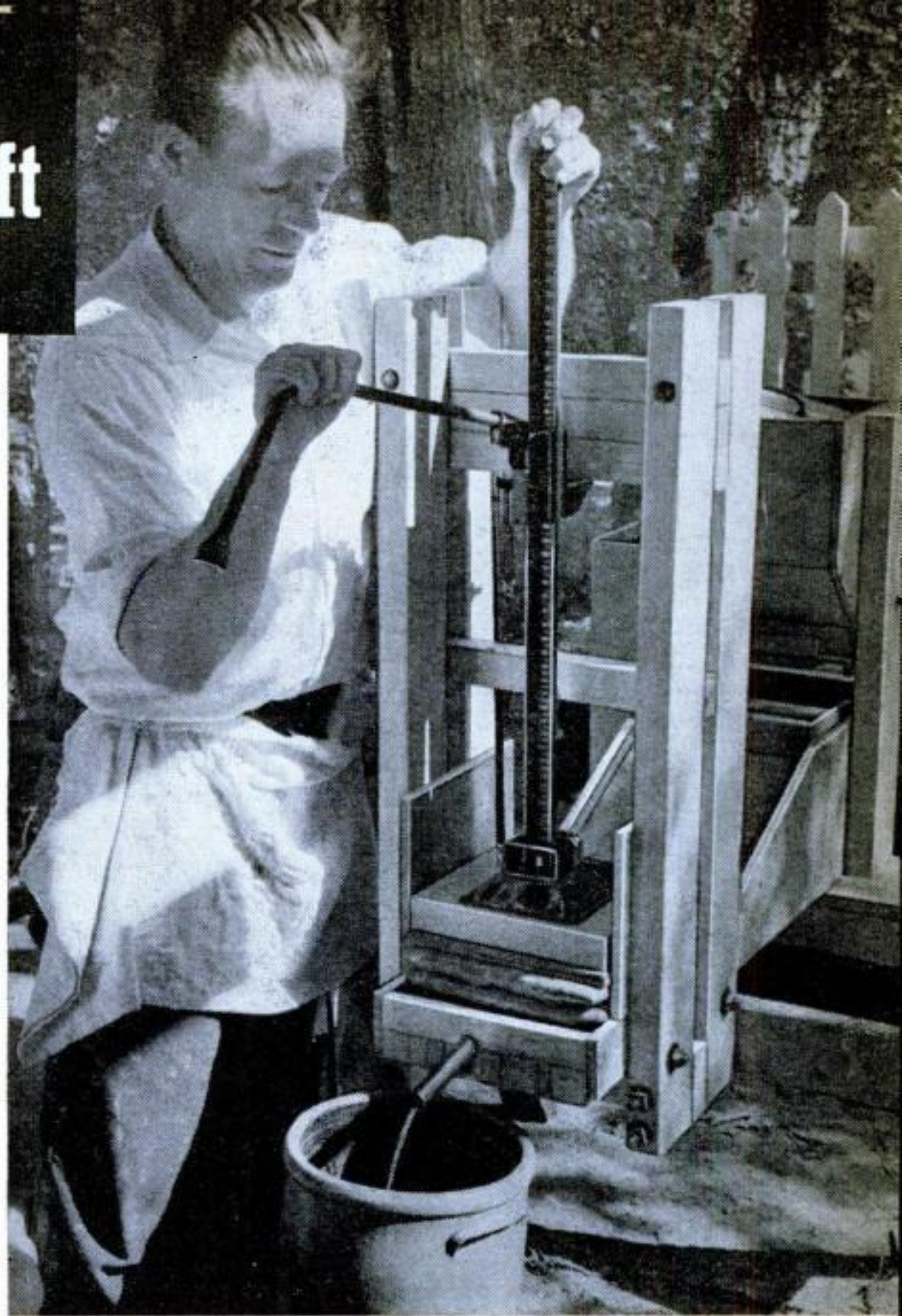
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Do you have an embarrassing shop blunder that haunts you? PS will pay \$50 for each such experience published. None can be returned. Keep it brief. Address: Shop Editor, Popular Science Monthly, 355 Lexington Ave., New York 17, N. Y.

Mechanics and Handicraft SECTION

The Rig You Need to Make Hard Cider

BUMPER JACK presses out juice after a grater chews up the apples.



By E. F. Lindsley

TAKE fall's crisp blue skies, the red and gold sparkle of hardwood leaves, a subtle touch of wood smoke, and the earthy aroma of heaped baskets in the farm cellar; blend them together into a single sparkling liquid and you have fall's brilliance and nature's bounty concentrated in that mellow drink for home and party—apple cider. That's what cider should be, but not necessarily what it is when presented prepackaged and pasteurized at the supermarket. The difference between the cider you can make and what you buy is as enormous as that between grocery bread and the tawny crusted loaves from grandma's kitchen.

And for those occasions indicating a

spot or two of something warming, hard cider is a real delight—even to a connoisseur—and a conversation piece to boot. A 50-gallon oak barrel in the basement will produce a rival to the finest white wine on the market.

Your own artful blending controls the character of the final sparkling liquid, either sweet or hard. For 50 gallons of cider to put in a charred oak barrel, and a bit of sweet to drink while waiting, you'll need 15 to 20 bushels of apples. For lesser pressings, suit yourself. But get enough varieties to blend. No one kind of apple produces really top cider, although a fairly decent juice might be made with McIntosh if they are fully mature.

Getting the juice out. To get the cider pouring, the apples must be reduced to

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Here's how to go about making your own cider press

a mush. The grater and press that I built puts production into high gear. The heart of the grater is a wooden rolling pin with a sheet of galvanized metal wrapped around it. Holes were punched in the metal with a center punch ground to a blunt end. This gives a grating action when the rolling pin is spun by an old washing-machine motor. The whole works is in a hopper made of exterior-type plywood. The chopped-up apple pomace spews out onto the cheese cloth and rack below.

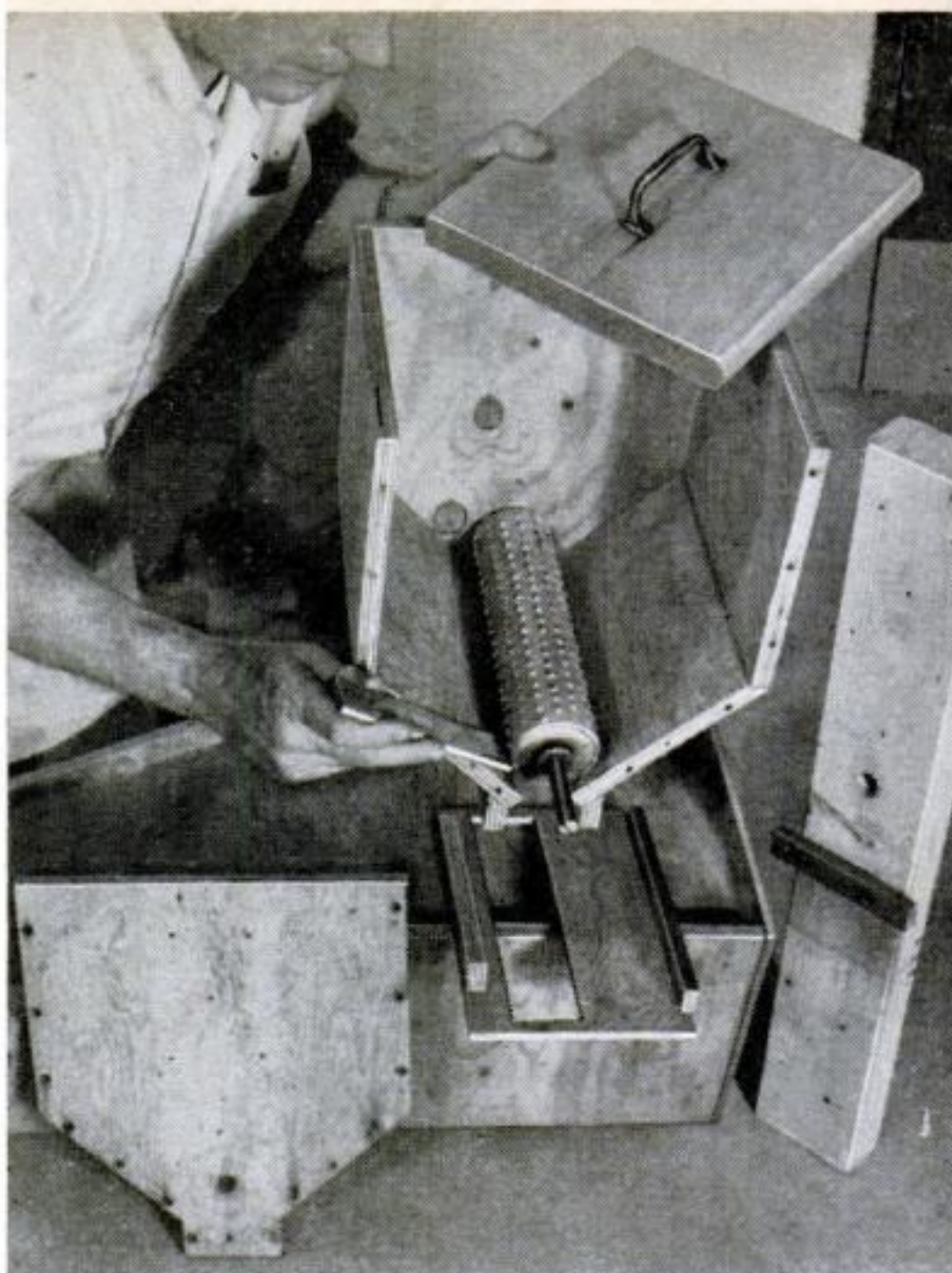
If punching the sheet metal seems a drag, try driving a few rows of flathead screws into the rolling pin so the sharp heads stick out $\frac{1}{4}$ " or so. Set the drum with no more than $\frac{1}{4}$ " clearance between the sides of the hopper and the grater.

A solid wooden cover with a secure handle should be cut to fit the inside of the hopper with no more than $\frac{3}{16}$ " clearance. This is used to force the apples down against the grater, and to keep apple mush from flying far and wide. A gate below closes the hopper while "cheese" forms are being changed.

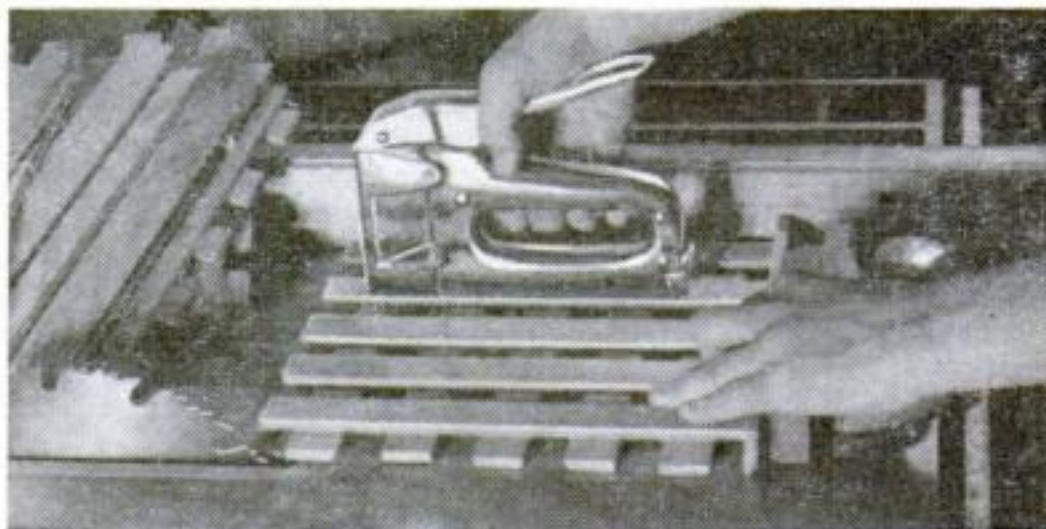
The press end. This doesn't have to be much for looks but it must be strong. Suit it for the jack you'll use and aim for a rig that can put about 150 pounds on each square inch on the press rack.

I used the bumper jack from my car. The only alteration was a $\frac{3}{16}$ " hole drilled in the lift arm for a small screw, run up through it into the frame cross member. This prevents the jack from kicking out and hitting you. Screen-door springs were installed to raise the jack when the handle is wiggled.

Oak or maple should be used for the cross members and pressing table. Long carriage bolts or threaded rods will beef up the structure to resist your pressures



ROTARY GRATER in a plywood hopper chews up the apples fast. The author used bronze bushings from an old motor for the drum shaft—a piece of $\frac{1}{2}$ " drill rod. Aim for a loose fit here.

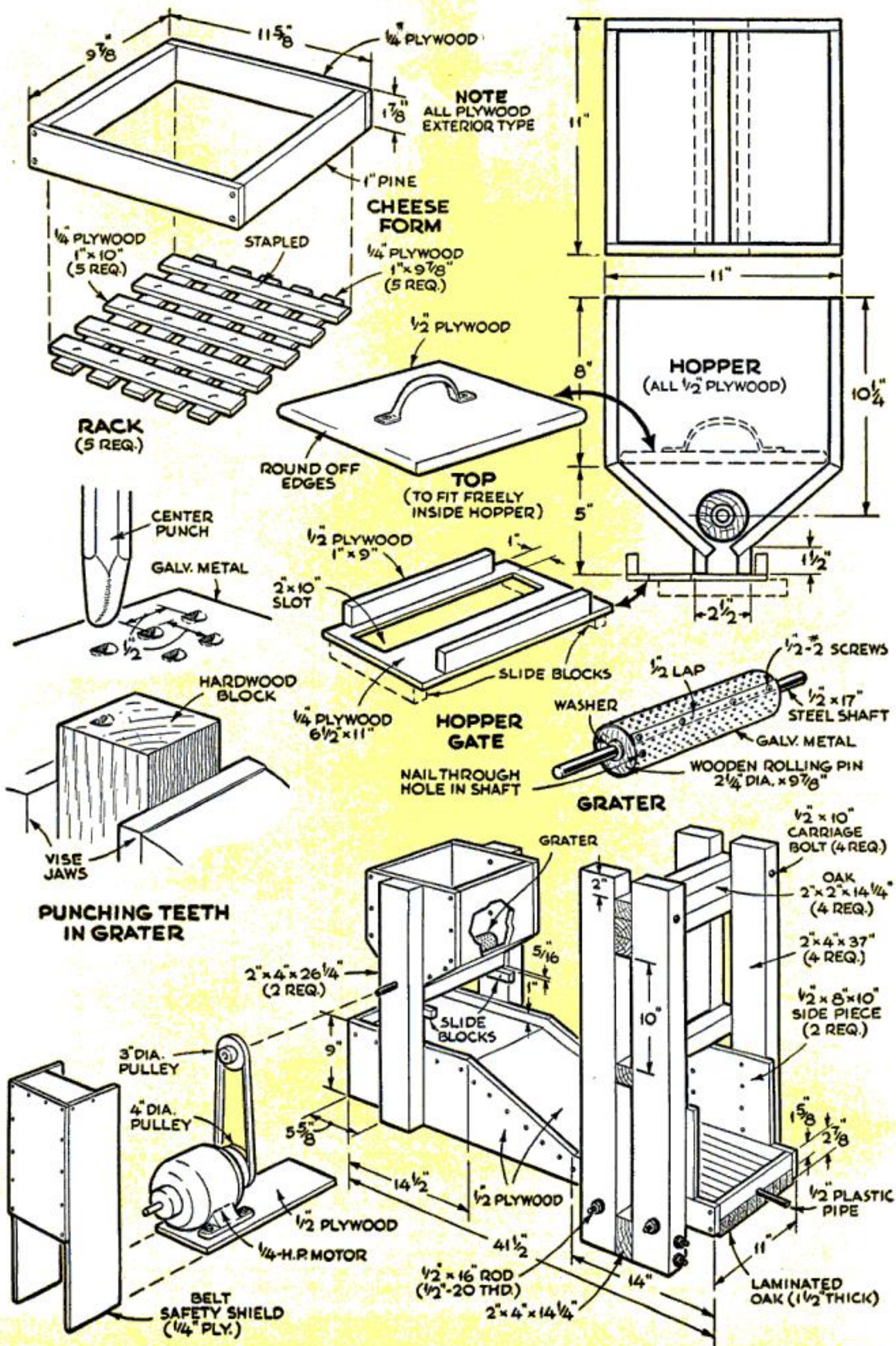


SLATTED RACKS of $\frac{1}{4}$ " waterproof plywood were made to fit inside cheese forms. Above, rip and crosscut guides on saw are used to keep the rack square while pieces are stapled.

HOW TO MAKE IT LEGAL

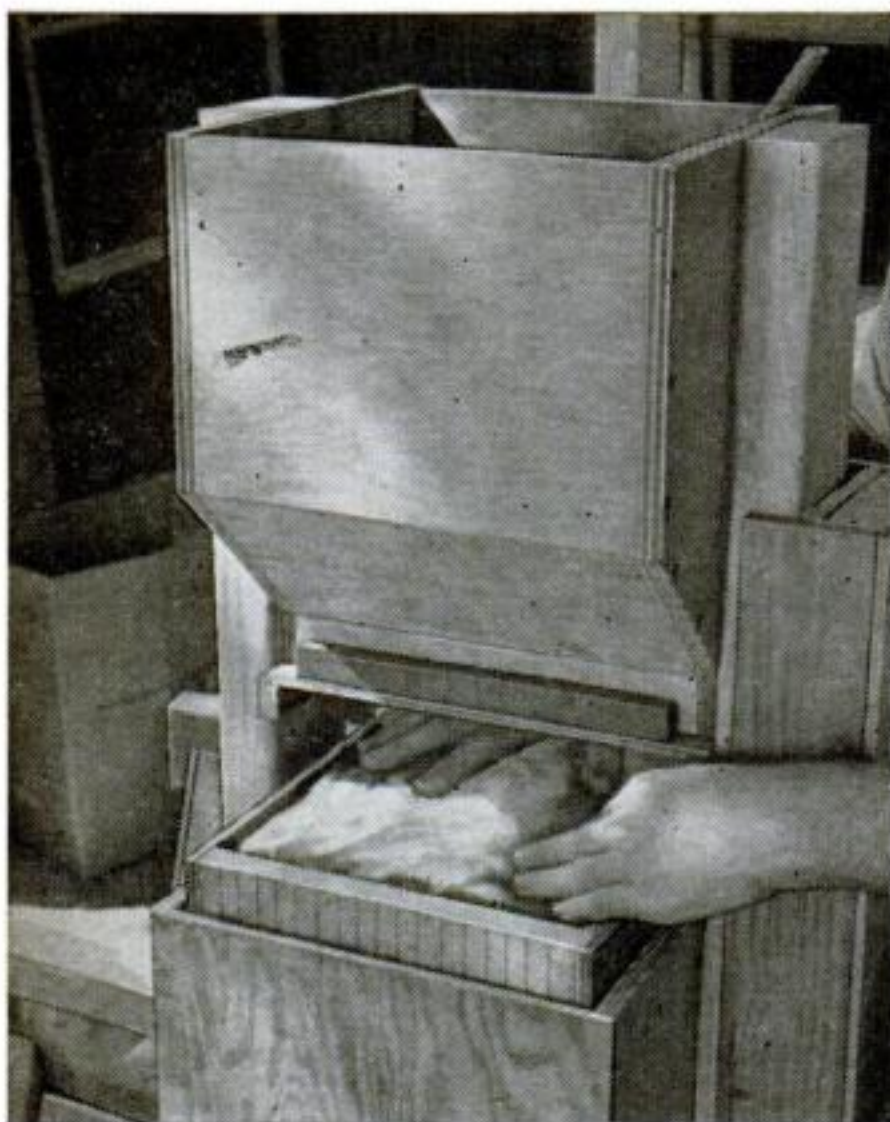
From the standpoint of the federal government, apple cider becomes a fruit wine when you add sugar to aid fermentation. Naturally fermented cider (with nothing added) is subject to no restrictions, but it may turn out to

be vinegar. If you add sugar as we suggest, you must file an annual notice (form 1541) with the Alcohol and Tobacco Tax Division of the Internal Revenue Service. You can then make up to 200 gallons for home consumption.



CONTINUED

Three important steps for turning the juice of



CLOTH IS FOLDED neatly over the apple mush after cheese form is full. Note the plywood belt shield on hopper support at right. It keeps fingers and cloth out of the moving belt.



TAPERED BUNG CUTTER makes for a snug, leak-proof fit. In rural areas you may be able to borrow a cutter. Get a new wooden bung. A used one may have undesirable bacteria on it.

when you're trying to ooze out the last few ounces to fill the last jug.

Don't use metal parts to handle the apple juice. If you want to protect the wooden table and racks, give the wood a coat of hot paraffin or a few coats of spar varnish.

The pressing operation. It takes a little experimenting to find out just how thick to build a "cheese"—in cider parlance, a flat, cloth-wrapped slab of apple mush. Three or four cheeses are stacked alternately with the slatted racks between. The press plate, a solid wooden slab, goes on top. Uneven loading of the cheeses will cause sliding and twisting under pressure. The cloth wrappers must

all be strong enough to resist bursting.

At first, I tried burlap in the time-honored farm style. Maybe I did something wrong, because the cider had little hairy particles in it. Monk's cloth worked fine, but it was hard to find and the coarse pattern let small particles through that later took an extra filtering operation. Finally, on the advice of a pro, I bought a war-surplus parachute and wound up with a tremendous quantity of nylon. This stuff is wonderfully strong and stretchy, washes clean after use, and is tight enough for filtering action. Plain muslin will do fine if you want to play around a bit at the start. Cut the cloth into squares that will fold up and over

WHAT APPLES SHOULD YOU USE?

Says the author: "A veteran commercial presser sums it up pretty well, hedging of course for varieties not grown in my home state of Wisconsin but common elsewhere . . . 'mature McIntosh for tartness, Jonathan for spice, Golden or Red Delicious for sweetness, Cortland for sweetness and long keeping.'"

Another listing, from the Michigan Agricultural Experiment Station, runs from Roxbury Russet through Baldwin, Northern Spy, R.I. Greening, McIntosh, Ben Davis, King, and Wealthy, in that order for juice quality. But whatever the blend, use mature apples in which the sugar content has peaked.

pressed apples into a fine drink



GLASS U TUBE with end immersed in water lets gas escape from top barrel hole, but keeps out air. Replace water in jar as needed to keep it from evaporating below the end of the tube.

nicely at each end and side to form a leakproof bundle. A slatted rack goes under the cheese form, with a piece of the cloth pressed down into the form.

Commercial cider makers go to fantastic lengths to filter apple juice and make it clear. If you wish, you can drip the juice through several layers of cheese cloth to get out the worst of the material. But your juice will still be cloudy. I decided it tasted just as good.

Short of pasteurization, impractical at the home level, the best storage of sweet cider is freezing. A modern deep-freeze will hold cider indefinitely until thawed again. A more desirable method of storage, in the opinion of many, is conversion to apple wine. If you can get 50 opinions on blending varieties of cider apples, you can get a hundred on the best wine-making system. Since the only practical container is a 50-gallon charred-oak cask, it takes quite a while to sample your way through different batches. I stick to one method; I know it works.

First get your barrel. A used 50-gallon whisky barrel is best. Since legal restrictions on the aging of bourbon limit the

WHERE TO GET A CIDER BARREL

The ideal container for making hard cider is a 50-gal. barrel originally used to age bourbon. These are made of white oak, charred inside. By law they can't be used for bourbon a second time.

You can sometimes buy one through a local cooperage house, cider maker, pickle maker, or truck-garden operator.

If none of these sources can help you, write to a distillery and ask whether one can be shipped to you.

commercial re-use of the numbered barrels, you can probably buy one cheap. If you're tempted to try a smaller quantity, remember the wine-making action seems to be better when larger casks are used.

Mount the barrel on a sturdy rack so it won't shake around and stir up the settlings. Choose a likely corner of a cool basement where it won't interfere with rumpus-room activities, or be too handy. If you own a home without a basement, maybe you can find someone with a cyclone cellar, mushroom cave, or just plain cellar, who'll make room for you. Technically, though, you're supposed to make—and consume—the stuff on your own premises, so you'd better check such an arrangement with local liquor authorities.

You'll find the barrel has a bung opening on the side. With the barrel on its side in the rack this bung should be on top. Get a new spigot of the wooden variety. Use a bung drill to open a place for it in the barrel end. When driving it in, use a board between the spigot and the mallet to prevent splitting. Afterwards, seal all around the bung with melted paraffin.

The wine-making process. Here you're converting sugar into alcohol by yeast action. The amount of sugar to be added to the cider depends on the sweetness or tartness of the cider, and the type of wine desired. Incidentally, use unfiltered cider. Presuming you have a cider of average sweetness, a pound and a half of sugar per gallon will produce a very lively wine. For tart ciders, use two pounds, for dry wines use one pound. Dissolve the sugar in the cider before putting it in the barrel.

[Continued on page 236]

SECRET JOURNEY. All youngsters like to crawl through a tunnel. This one—a big sewer pipe—has a picture of a bunny painted on it.



How one town got **Free Playground Equipment**

WHAT can you do with defective sewer pipe? Most municipalities would just reject it, but not the township of Union, N. J. There, Mayor F. Edward Biertuempfel Sr. has converted several sections of defective pipe into colorful and highly successful pieces of equipment for the municipal playgrounds.



MAYOR WITH PAINT POT putting the finishing touches on one of the turtles. Note the image of a whale on pipe in the background.

RIDE THAT TURTLE. Little sister takes an imaginary jaunt on the back of a sewer-pipe turtle. Its head and feet are made of wood.





Short Cuts and Tips

FROM PS READERS

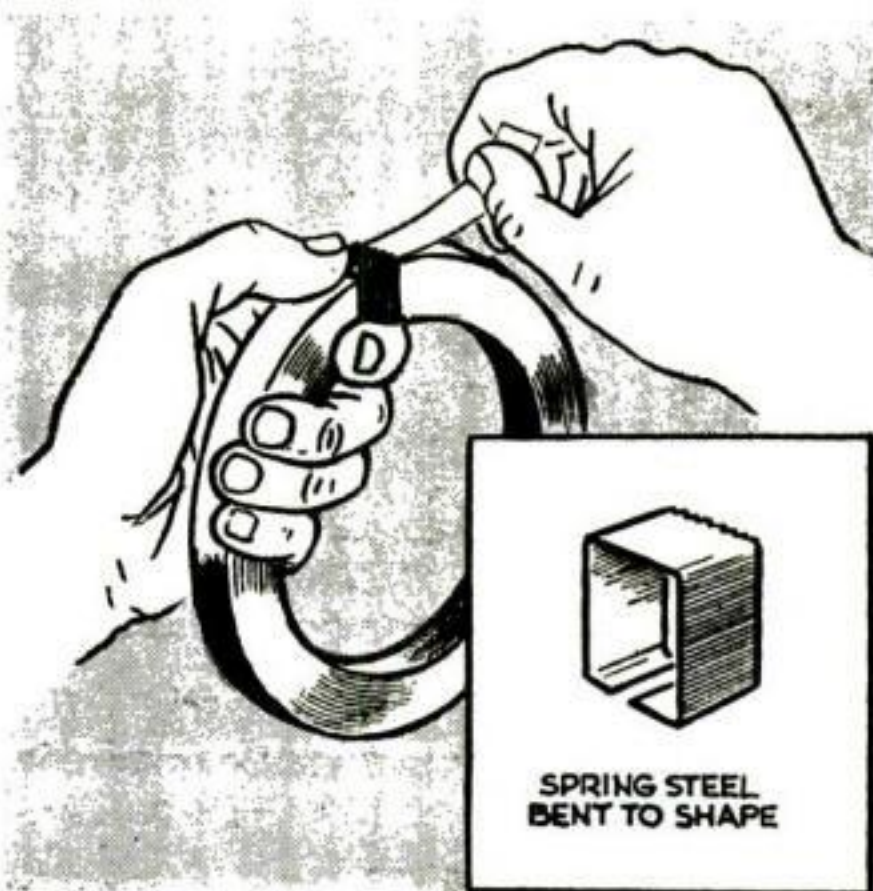
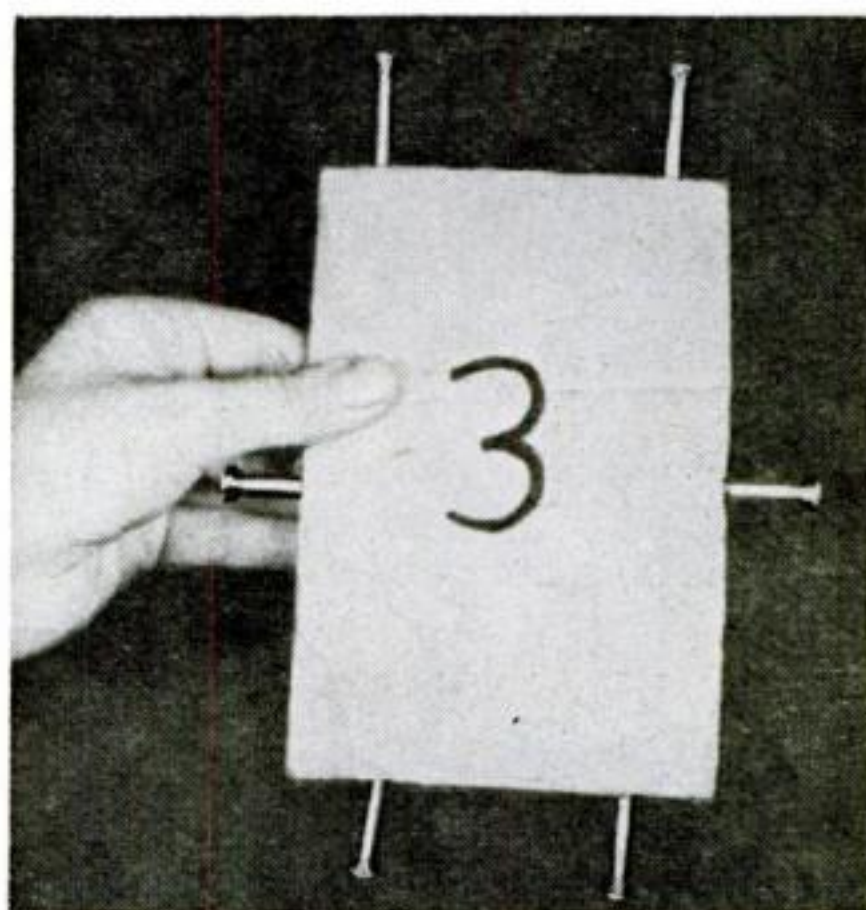
Party Dress for a Game-Room Piano

THAT out-dated upright in the family room doesn't have to be an eyesore. "Up-holster" it with self-adhering vinyl plastic, cut to fit. It'll be the focal point at your next party. The new surface wipes clean with a sponge dipped in soap suds.

Index Board for Sash Screws

TO ELIMINATE trial-and-error fiddling to match the right screw with the right hole when I install my storm sash, I devised my own "filing system." As I remove each sash next spring, I'll position the screws in a 3"-by-5" piece of corrugated cardboard to correspond to their locations in the sash frame. I number cards and windows in pairs. The system cuts installation time in half.—*Arthur S. Green, Lake Zurich, Ill.*

▶▶▶THE next time you find yourself stuck with a lot of posters to dash off for the church bazaar or club dinner, try lettering them with liquid shoe polish. You don't need a brush; just use the dauber.—*L. Murphy, New Hyde Park, N. Y.*

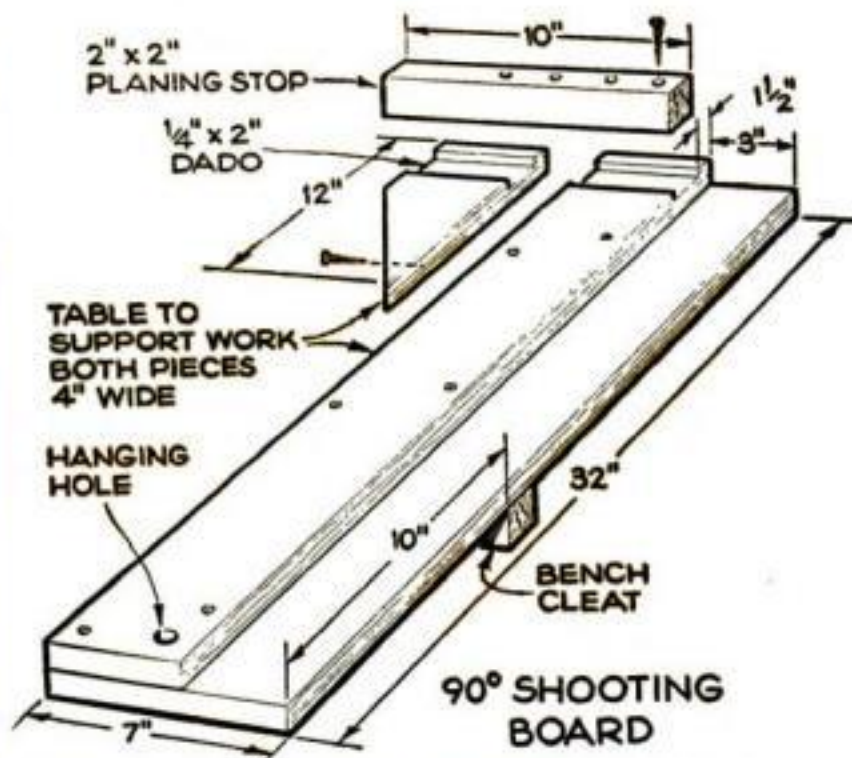
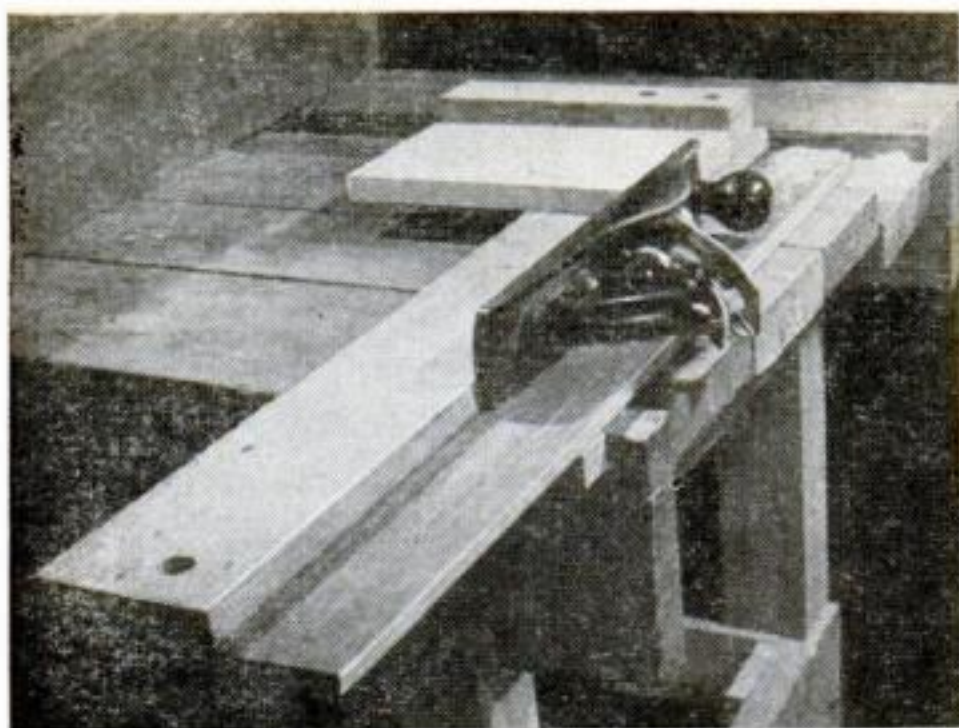


SPRING STEEL
BENT TO SHAPE

Cutter Clip for Masking Tape

RAGGED tears waste masking tape. This sliding clip cuts strips neatly and to precise lengths. Bend spring steel to a snug fit, file small teeth on a top edge, and snap the clip onto a full roll. Hold the cutter in place with a thumb; after tearing a piece off the roll of tape, slide the clip back to its next cutting position.—*Bernard Middleton, Muncie, Ind.*

▶▶▶Good rust-resistant patches can be made from the aluminum cans that many motor oils now come in. Cut off the ends, slit the tube and flatten it for patching roofs, floors beneath linoleum, and other spots requiring a durable repair.—*John Mihalick, East Liverpool, Ohio.*

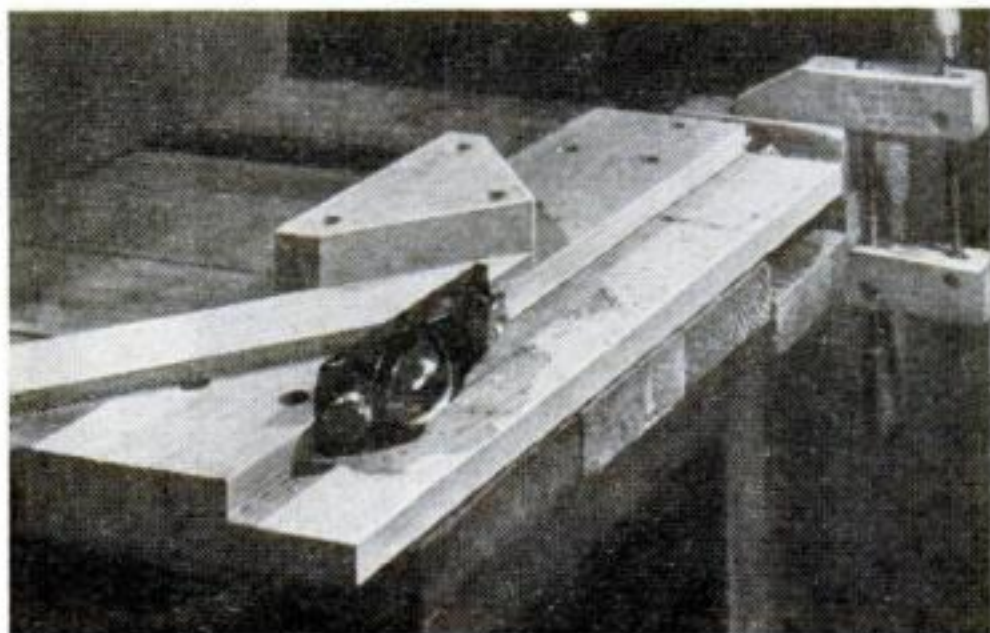
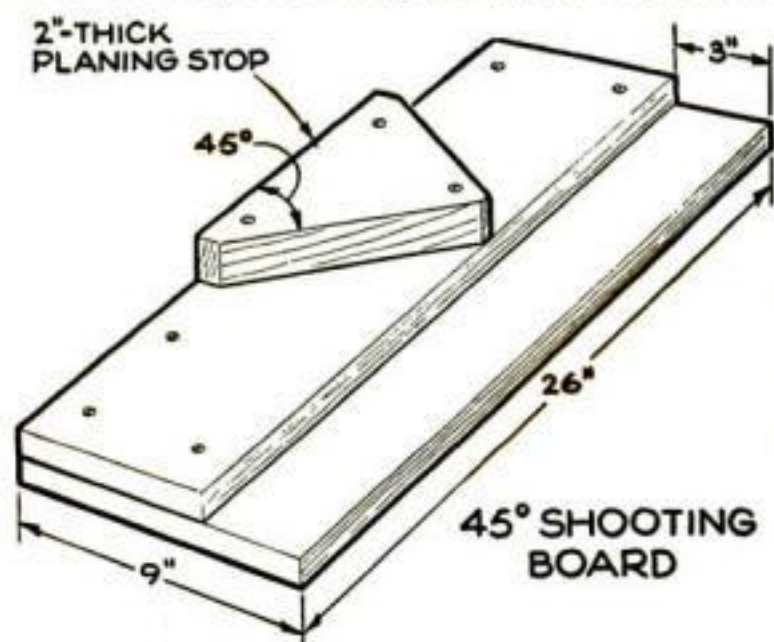


RIGHT-ANGLE SHOOTING BOARD has cleat underneath to keep jig from riding forward across

VERSION FOR TRUING MITERS has center-mounted stop so that planing can be done from

workbench. Stock to be trimmed is held tight against stop and plane is tipped on its side.

either end of jig. No cleat can be applied underneath, so a stop block is clamped to bench top.



Woodworker's Shooting Board

Few professional cabinet shops would be without several of these simple jigs

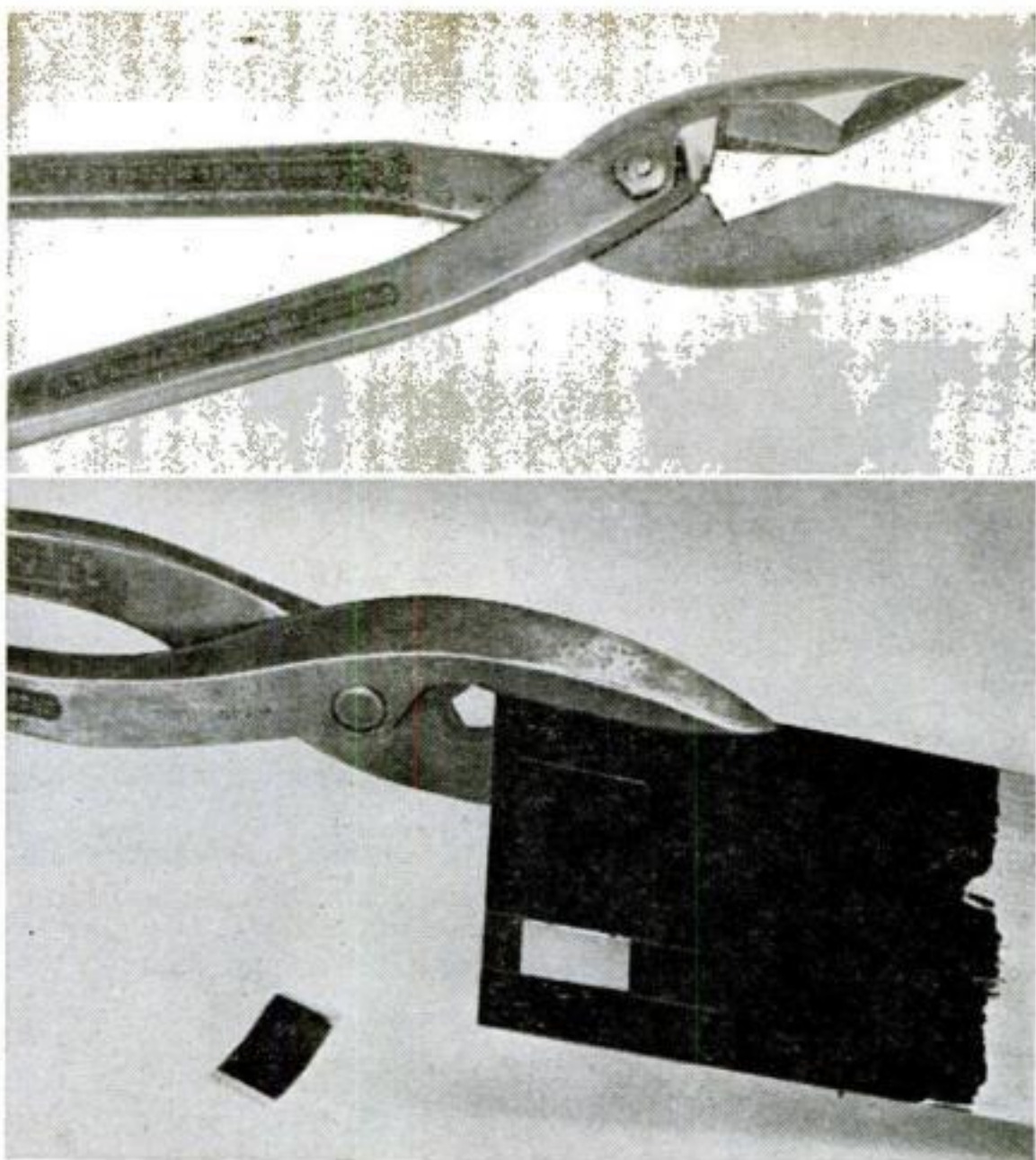
FOR better woodworking, borrow an old trick from the expert cabinetmakers. Use a shooting board. It's a hardwood jig for truing edges with a hand plane. Most commonly, such boards true work at 90- or 45-degree angles.

Make them of straight-grain (preferably edge-grain) hardwood. Assemble the parts with glue and countersunk flathead screws. The angle layout is critical. Check it with a protractor. You can vary the dimensions shown to suit the size of your wood scraps.

The 45-degree version—commonly used for truing miters—has a two-way planing

stop at the center. This is so you can place the flat back of a shaped molding against the jig table, no matter which end you are trimming. You couldn't get a true miter with the shaped face down.

Lay work to be trimmed on the top level and press it tight against the planing stop, with an edge or end projecting into the guide channel. Set the blade of your plane (block, smooth, jack, fore, or jointer) for a shallow cut and lay the plane on its side, seating it in the channel. Rub the channel with paraffin so the plane slides more easily.—*Claude Venon, Rowayton, Conn.*



Short Cuts and Tips

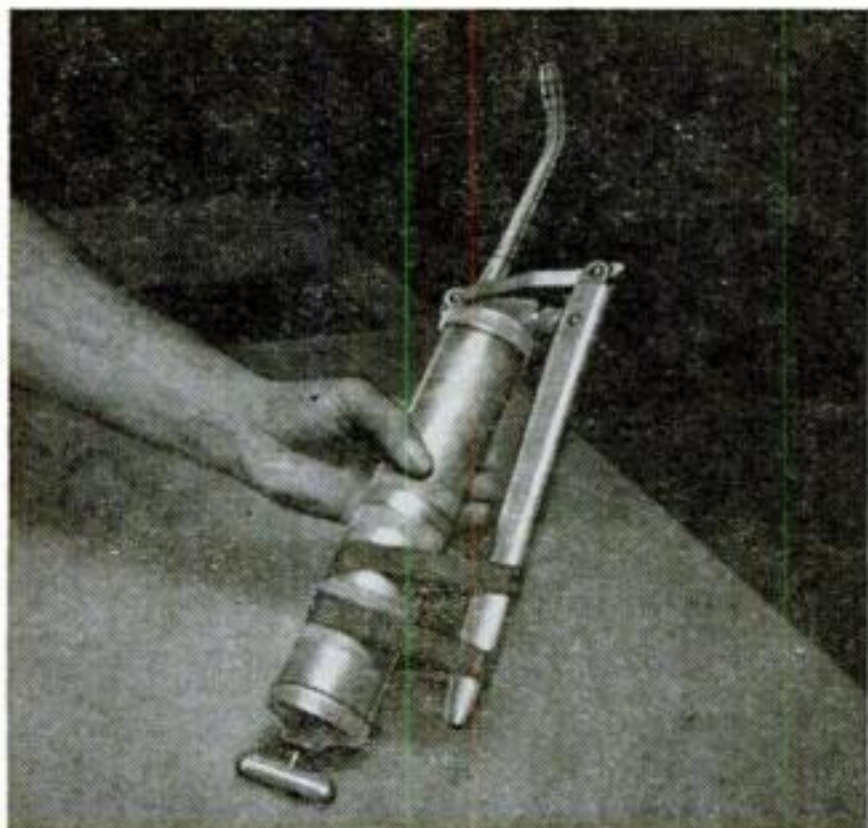
FROM PS READERS

Tin Snips Make Inside Cuts

MY OLD tin snips were beyond sharpening for normal use, so I notched-ground the blades, as shown. Now, they'll make internal cuts that would otherwise have to be chiseled. I removed the pivot screw and ground back the inside half of each cutting edge to an angle of 30 degrees. The new cutting edges were raked back at about 10 degrees for a clean shearing cut. The snips will cut either small enclosed openings or long slits.—*H. J. Gerber, Stillwater, Okla.*

▶▶▶ **BANISH** poison ivy by spraying the vines with three pounds of salt dissolved in a gallon of soapy water. Douse the ivy on its first appearance next spring and repeat until the leaves wither.

▶▶▶ **MARKS** left on porcelain sinks by pots and pans can be "erased" with an ordinary cork. Wipe the sink dry, sprinkle scouring powder on the area, and rub the marks briskly with the cork.



Grease Gun Is Leakproof

YOU can prevent the escape of grease from a stored gun by holding the handle snug to the body with rubber bands sliced from an old inner tube. Slip on as shown.—*John Mihalick, East Liverpool, Ohio.*

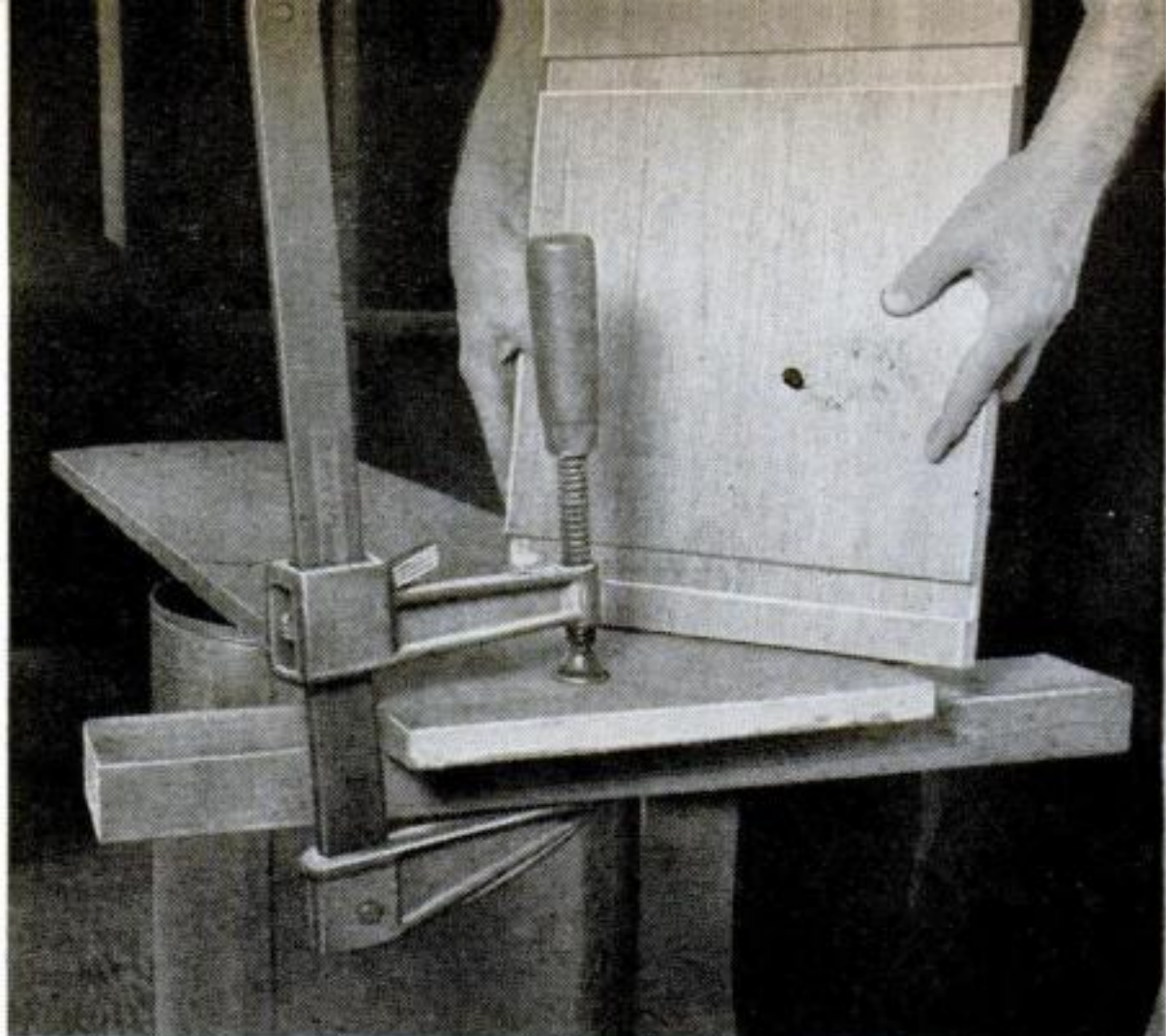


Hook Holds Ladder Legs

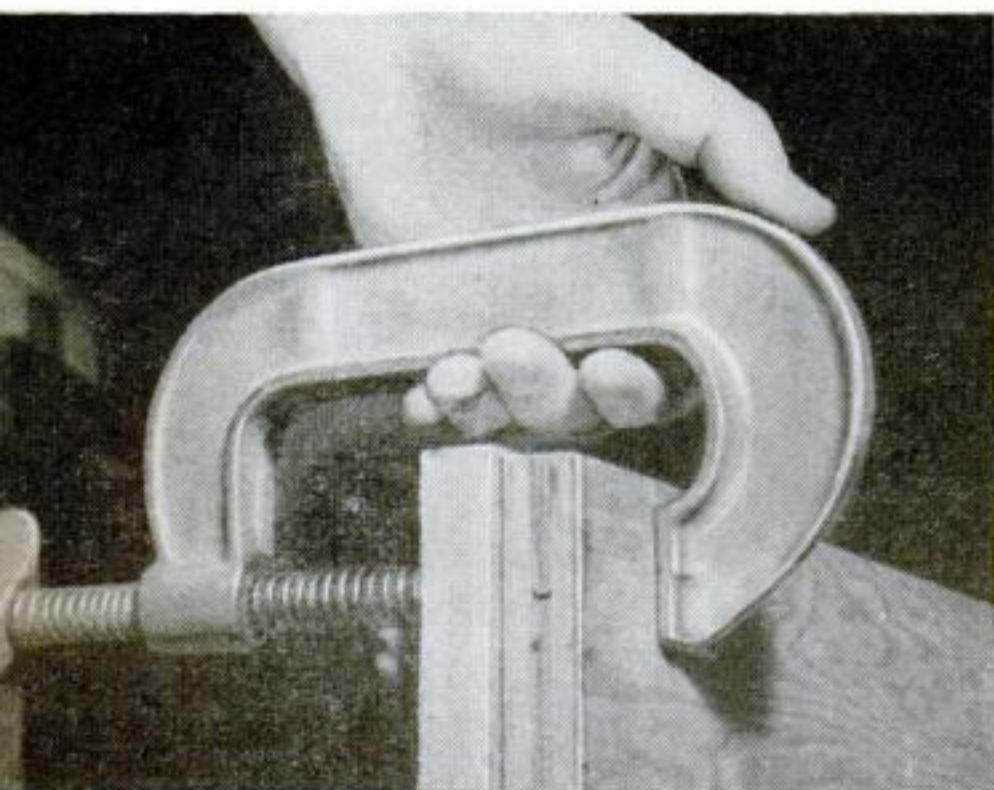
CARRYING a folding step ladder can be awkward if the legs keep swinging apart. A screen-door hook, installed for a tight fit on the legs, keeps the ladder folded.—*Wayne Floyd, Fayetteville, Tenn.*

17 Useful Tricks with Clamps

By Darrell Huff

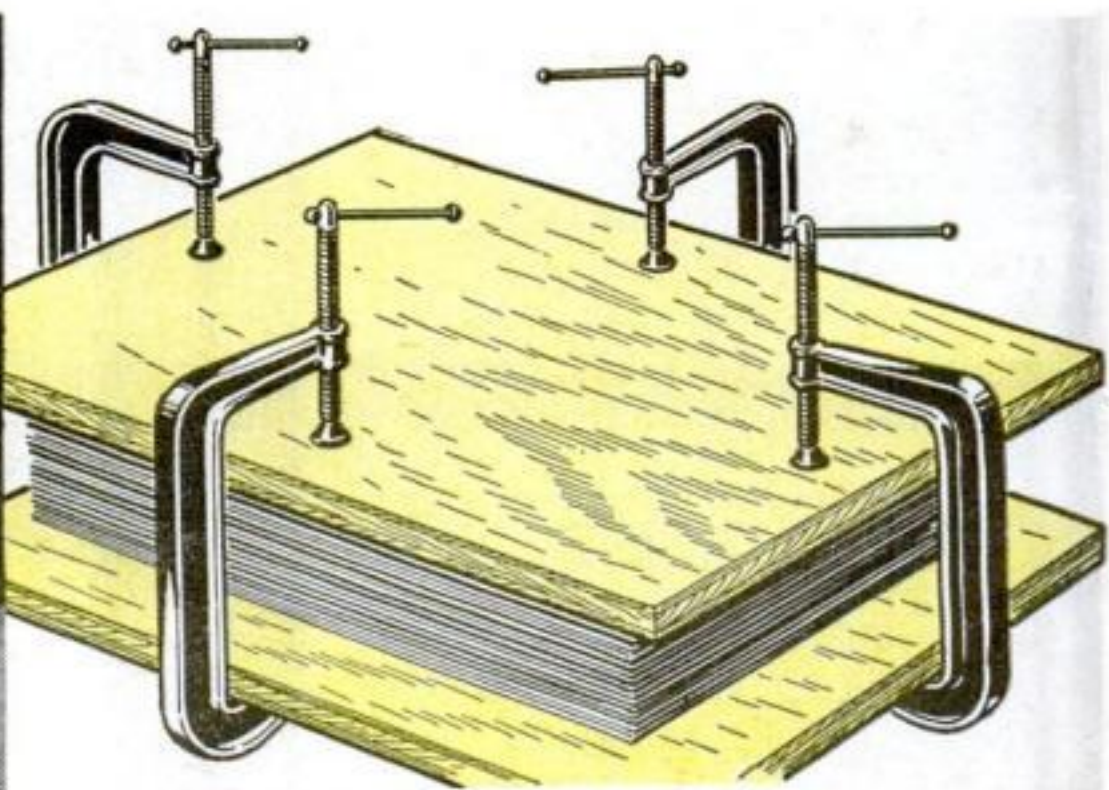


A BADLY CUPPED BOARD can be made to fit into a dado by first drawing it up flat against a length of two-by-four with a large clamp.



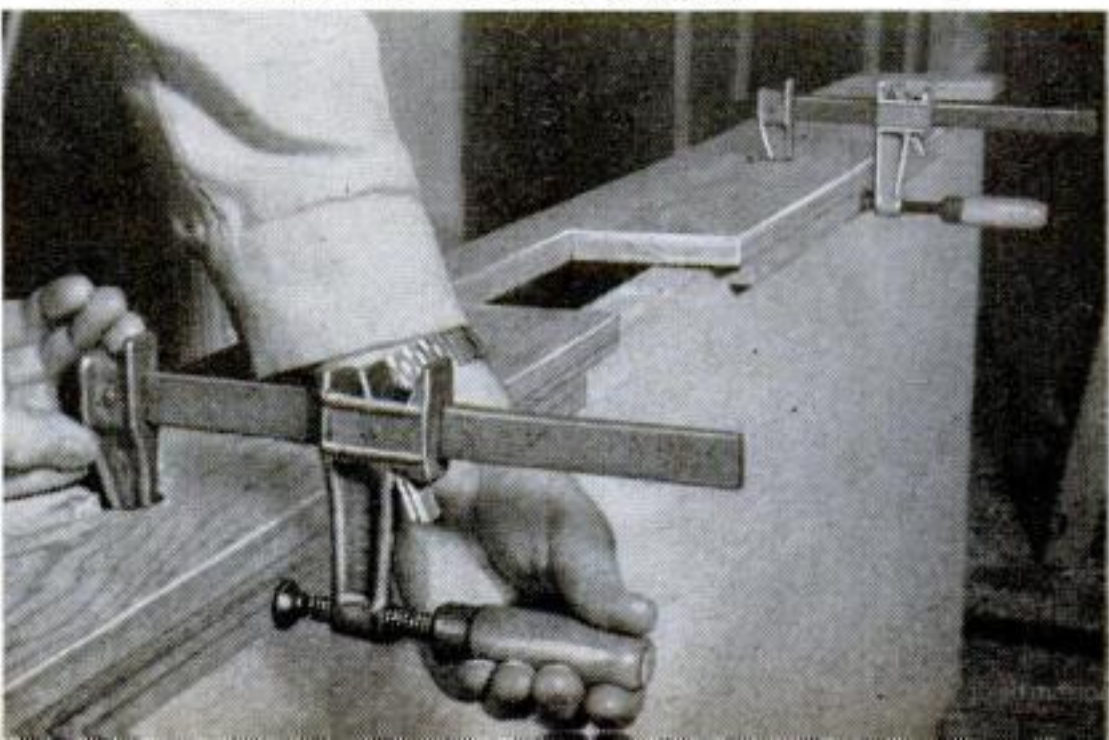
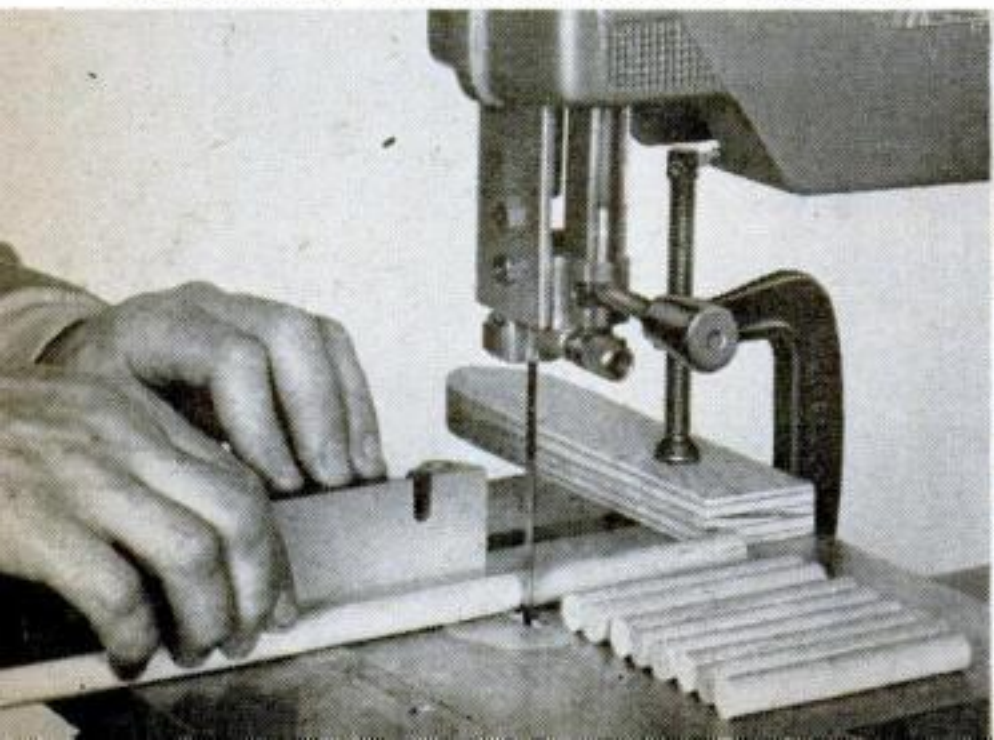
YOU CAN GET A GRIP on large, awkward sheets by attaching a pair of C clamps for handles. Pad clamp jaws on easily marred materials.

MULTIPLE CUT-OFFS ON A BANDSAW or jigsaw come out fast and accurately when you clamp an auxiliary wood-block fence to the table.



A QUICKLY MADE PRESS for gluing or flattening jobs consists of two boards and four clamps, giving tremendous, uniform pressure.

A HINGE-LOCATING JIG like this, used with a router, speeds the tricky job of cutting mortises when you have several doors to hang.

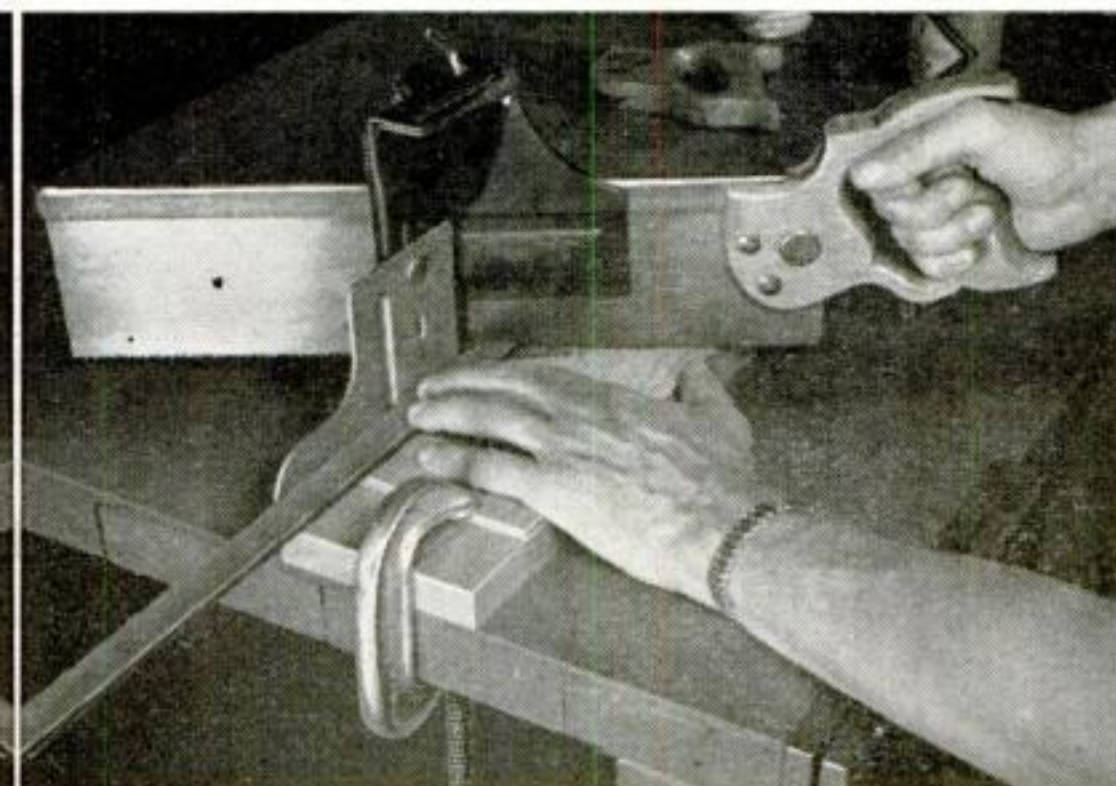




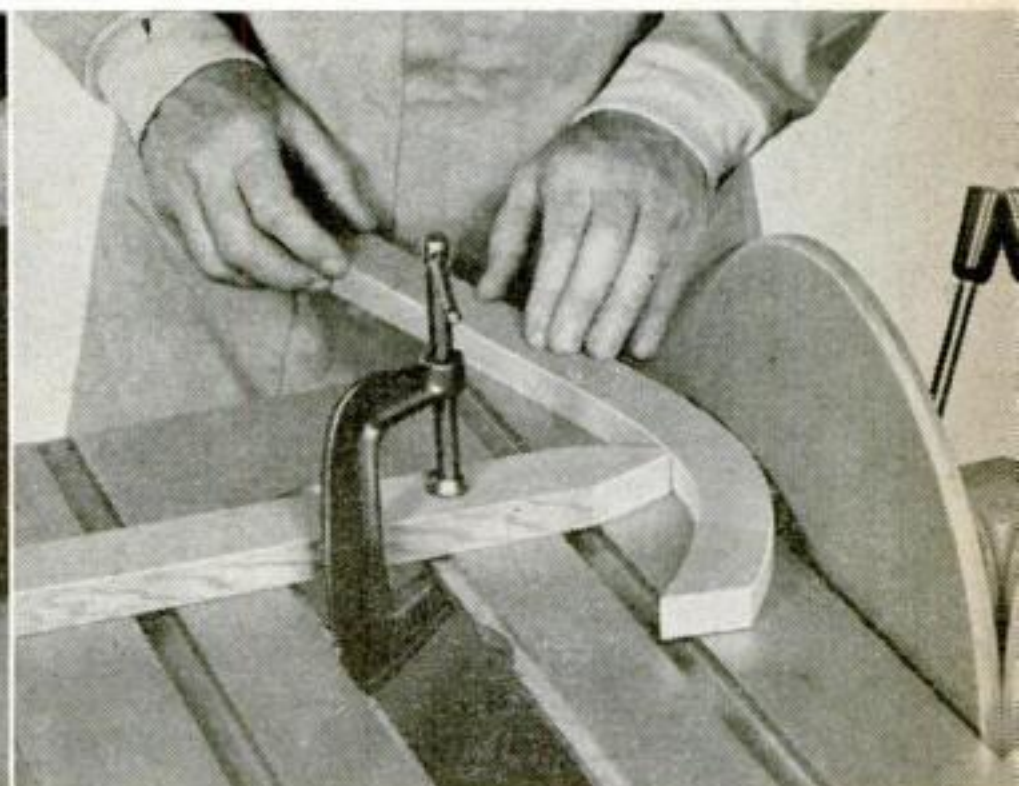
NUDGE STUBBORN PANELS into place with this setup. Wood block clamped to the furring strip makes an adjustable rest for the crowbar.



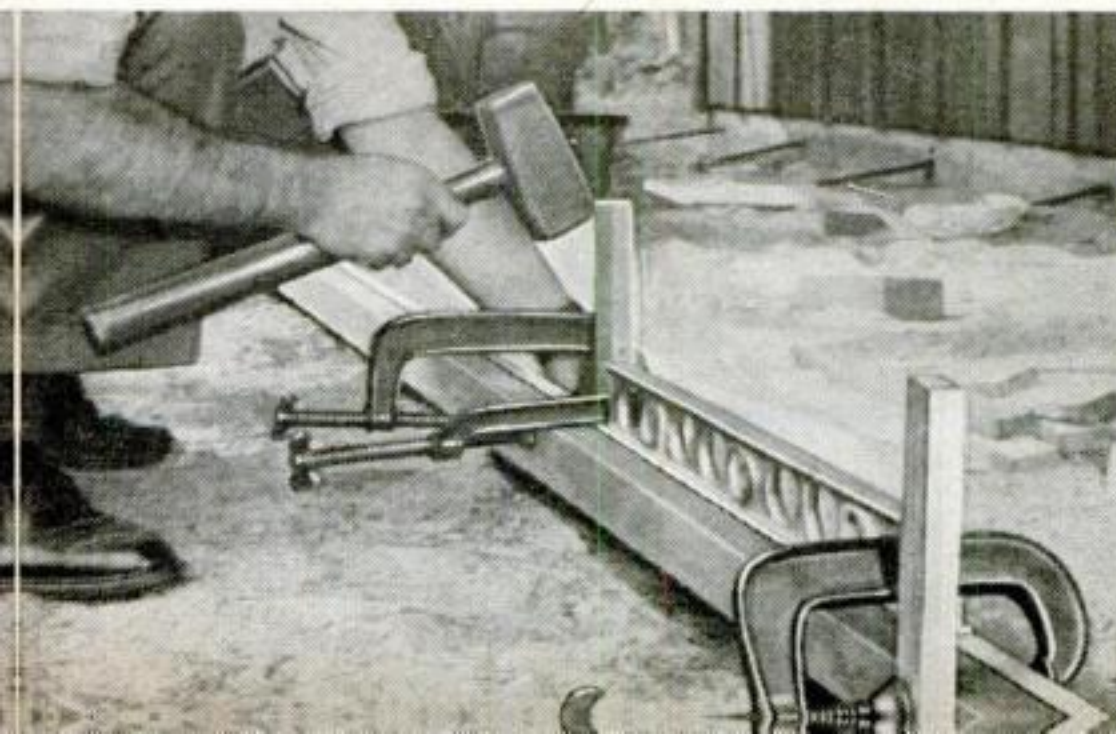
HANDLE A HEAVY BEAM this way and no helper is needed. Rest one end on a cleat clamped to a post or rafter while you fasten the other.



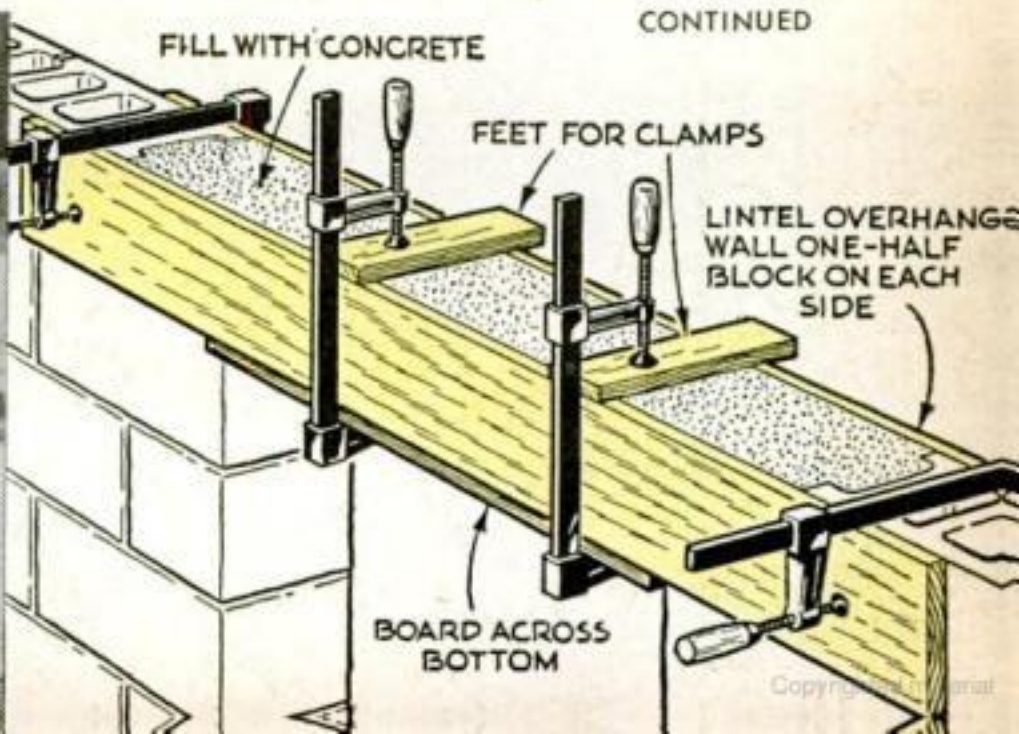
YOUR MITER BOX WON'T SLIP if you clamp it down like this. Use the same dodge to fasten it to a sawhorse for on-the-job miter cuts.



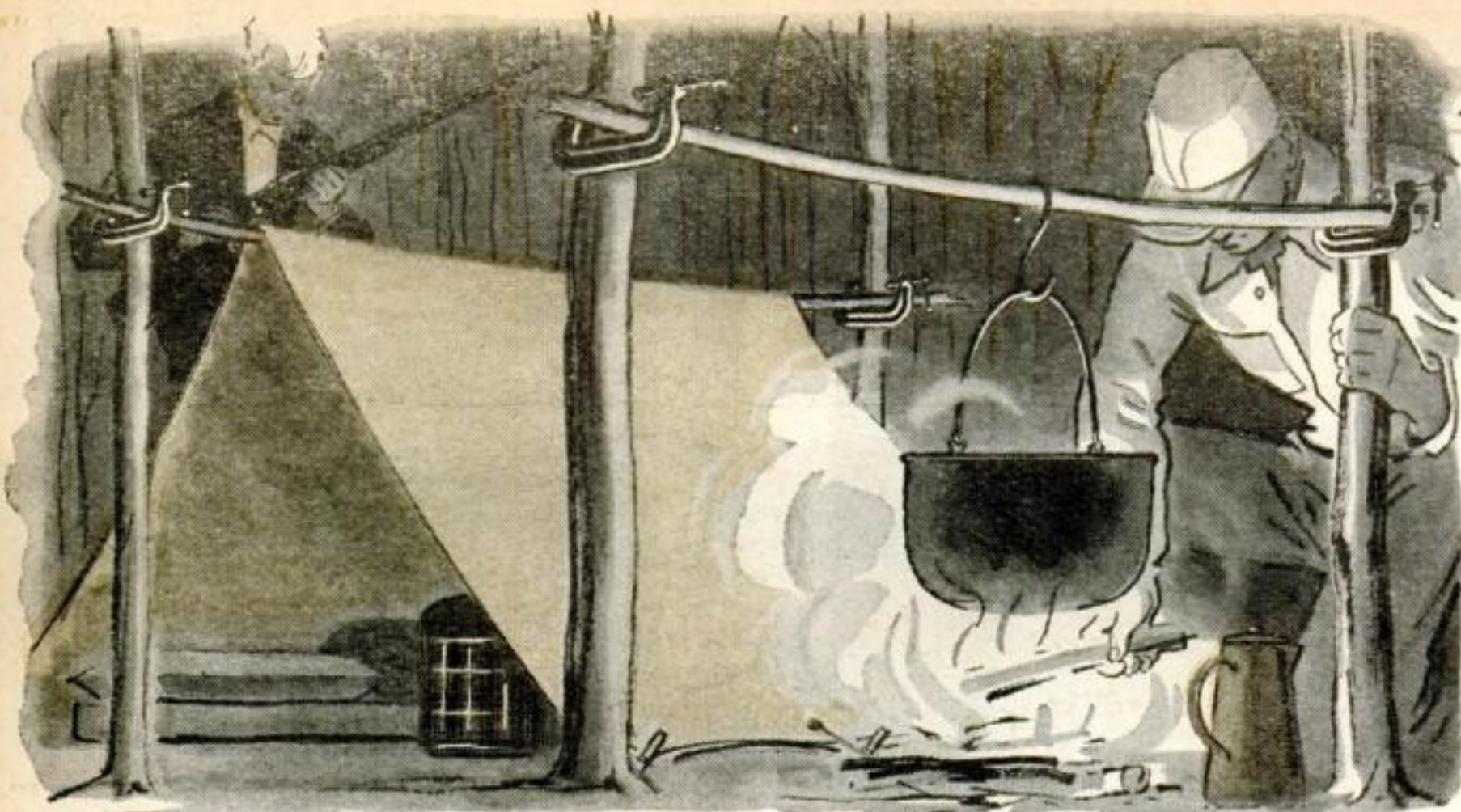
A CLAMP BECOMES A JIG for sanding curves. Inner edge of the work rides against pointed stick, duplicating the shape on the outer edge.



CONCRETE FORMS GO UP FASTER and are more accurate if you clamp the boards to stakes. Tap them level before you nail them in place.



CONTINUED

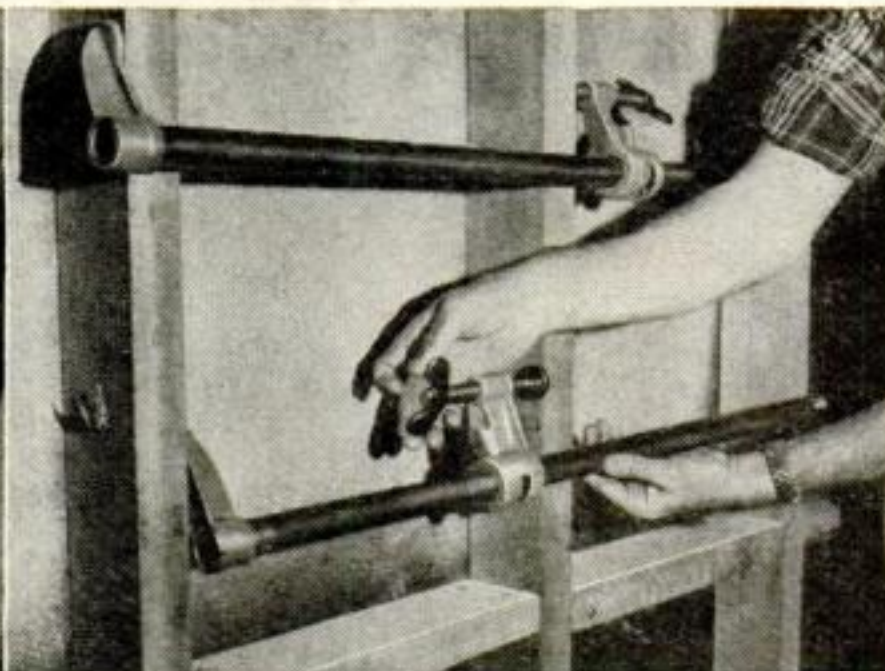


GOING HUNTING? A couple of pairs of clamps will let you put up shelters, cooking supports,

and other temporary structures without driving a nail. They'll knock down fast, too.



FOR TIGHT JOINTS IN PANELS, squeeze the boards with a long bar or pipe clamp as you nail. Pad the tongue with a grooved scrap.

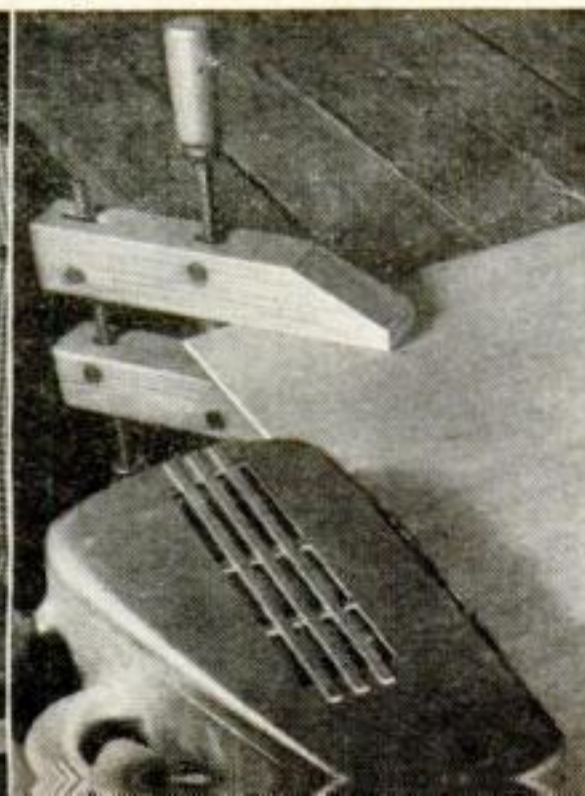


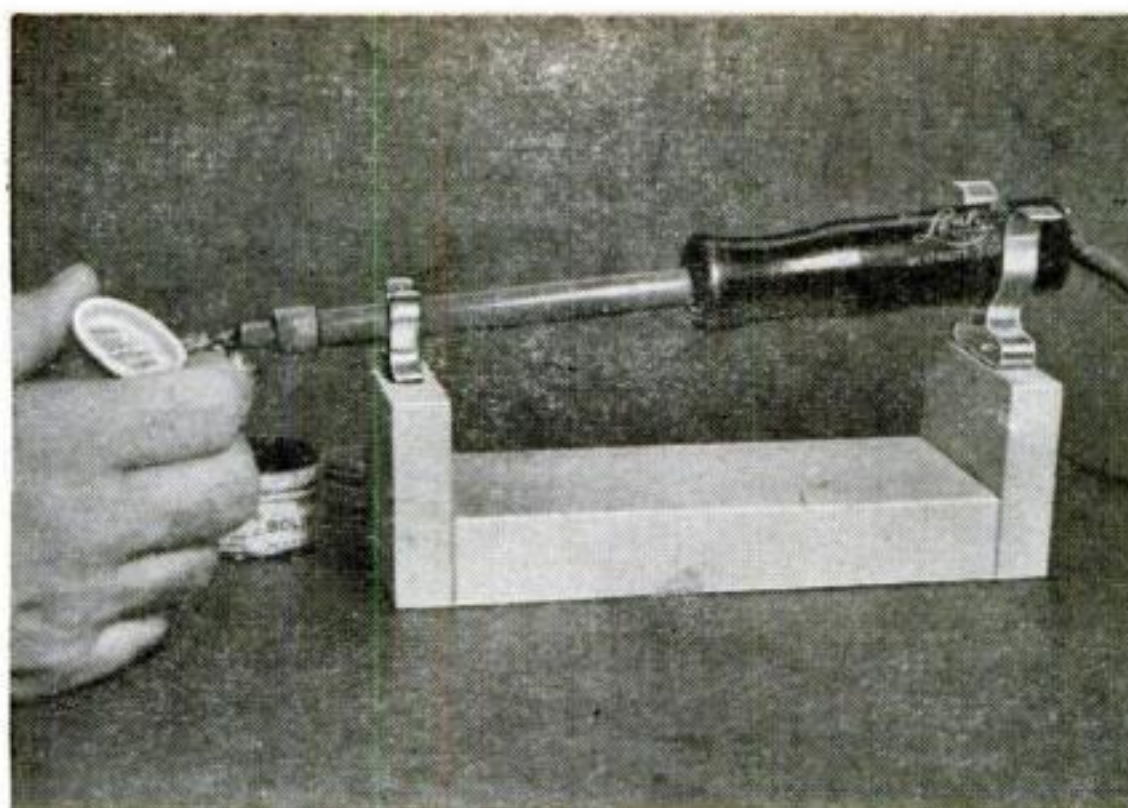
YOU CAN JACK THINGS APART with this special clamp made by the Adjustable Clamp Co. Its jaws can be reversed to push instead of pull.

NEED A TEMPORARY PROP on a job? Don't bother to cut one to exact length. Splice two scraps with a clamp and adjust them to the length you need.

NO SPECIAL TABLE is needed to use a sanding drum this way. Just block the work up on a board clamped to the regular table.

EVER TRY TO EDGE-SAND a thin board? Here's a sure way to keep it steady and flat as you work. A broad-jaw woodworking clamp is best kind to use.



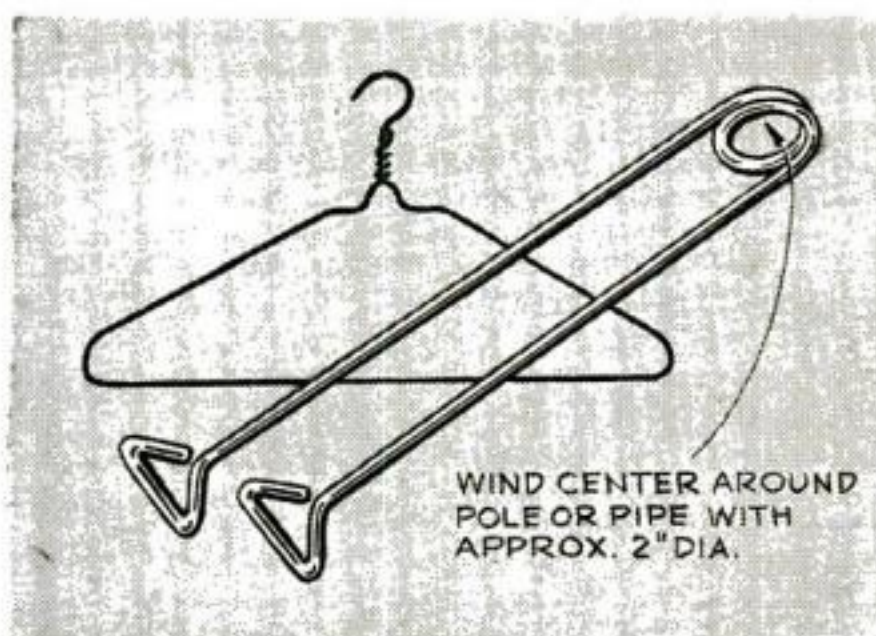


Short Cuts and Tips

FROM PS READERS

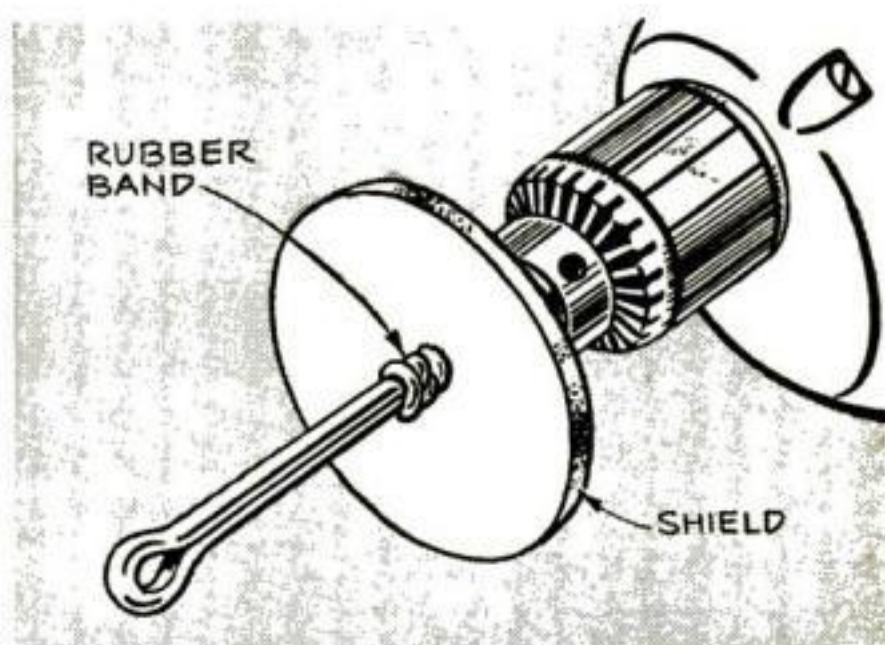
Scrap-Wood Rack for Soldering Iron

NAIL three pieces of scrap together, attach two spring clips of different sizes to the top edges, and rack your soldering iron. Both hands are then free to do the work.—Anthony Capotosto, Jersey City, N. J.



Barbecue Tongs from Wire

MOST meats retain their juices and flavor best if they're not pierced with forks while cooking. You can make a pair of cook-out tongs for turning or lifting steaks or chops by straightening a heavy wire coat hanger and rebending it as shown.—F. C. Gardner, San Angelo, Tex.



Paint Mixer Spins Small Cans

CHUCK a large cotter pin in your electric drill to mix half-pint cans of paint. To protect the drill chuck from spatter, pierce the can lid and pass the cotter pin up through it—or slip over it a cardboard shield held in place with a rubber band.—Charles E. Tuma, Lombard, Ill.

Clown-Faced Jar Sprouts Grass Hair

HERE'S a project to keep a restless child occupied on a stormy Saturday. Let him paint an empty jar white and decorate it with a clown's face. Fill the jar with top soil and scatter grass seed over it. In a week or so, the clown will sprout a luxuriant head of hair that the child can trim to various shapes throughout the winter months.—Joe Cerra, Dunmore, Pa.





A TWO-OWL UNIT makes a simple, unusual display. X marks on top owl show where wood will be removed, leaving ears. Note how expressions are varied by making the faces thin or fat.

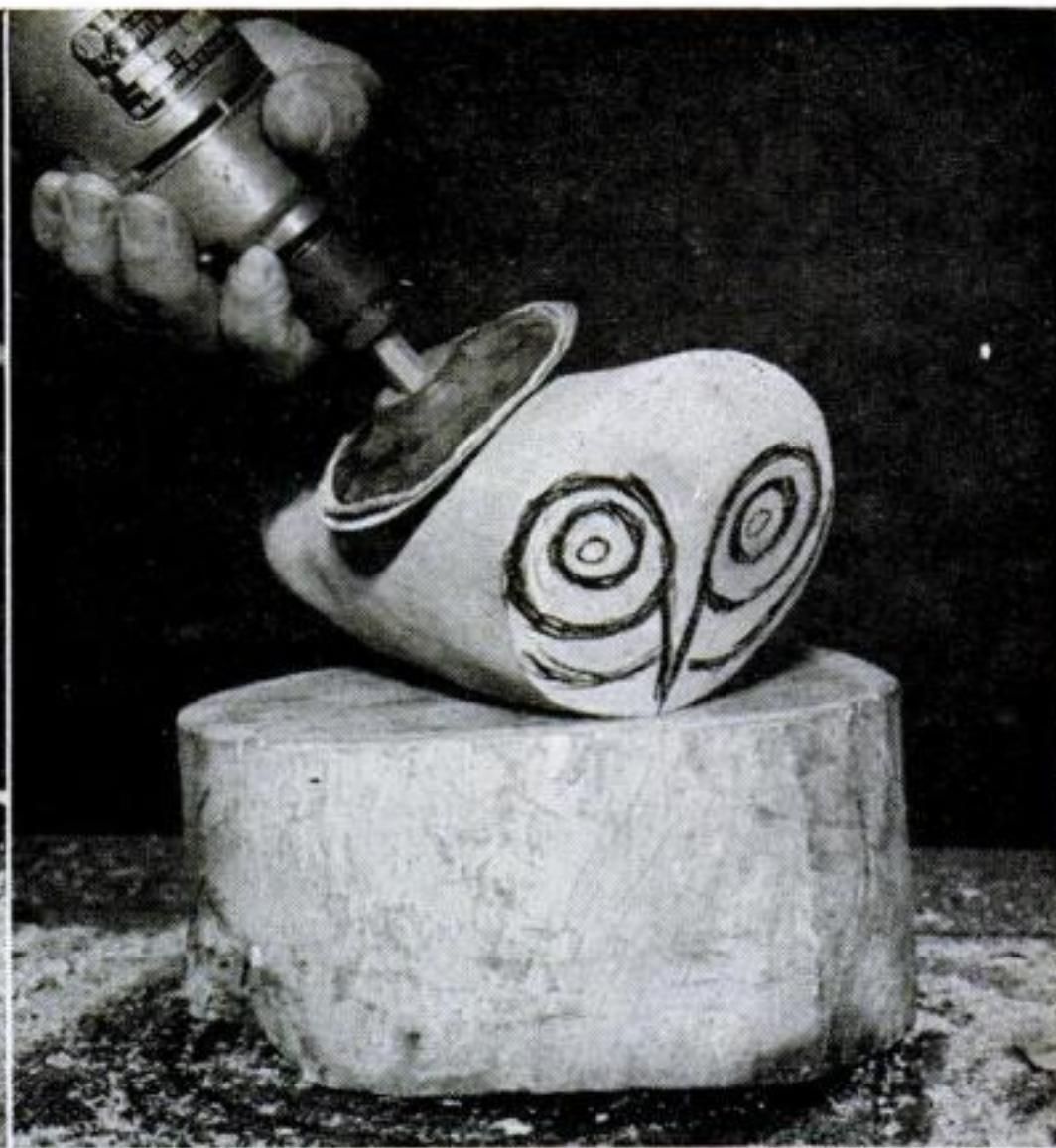
By
R. E. Byers

Fast Carving with Power Tools

A wacky art—turning out picturesque objects with electric drill or hand grinder. Here's how you can do it



1 STUBBY LOGS are first rough-shaped with a hatchet and rasp to form a cone, broad in front and narrow in back. Sawing butt end on a slant gives appearance of forward-jutting face.



2 SURFACE IS SMOOTHED with a medium sanding disk on a flexible pad. Outlines of face are roughed on with a grease pencil. Two $\frac{3}{8}$ " dowel pins hold the carving on the heavy base.



AS CRUSTY A BUNCH of wise old owls as you'd ever want to see, these rough-hewn carvings make a handsome mantel or garden decoration. They're pegged to the tree limb with dowels.



3 TINY ROTARY FILE quickly routs out wood between the lines, leaving high spots. Such files work best in a high-speed hand grinder, but can also be used in an electric drill.



4 A RICH, TEXTURED EFFECT is easy to get by burnishing with a small stone abrasive. Cypress chunks ("knees") are ideal for the carvings, but any wood, even soft pine, will do.

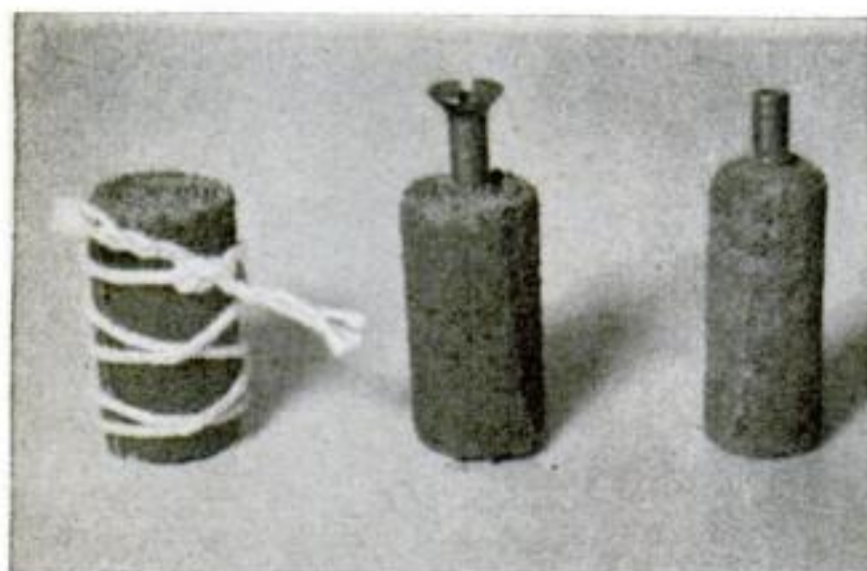
Short Cuts and Tips

FROM PS READERS



Keeping Paint off Wallpaper

WHEN we nailed up new moldings around our home, we slipped 3"-wide strips of paper behind the wood. Painting the molding then went fast and easy with no danger of splattering the walls. The strips of paper were slipped out afterward.—*Henry V. Lukas, Los Angeles.*



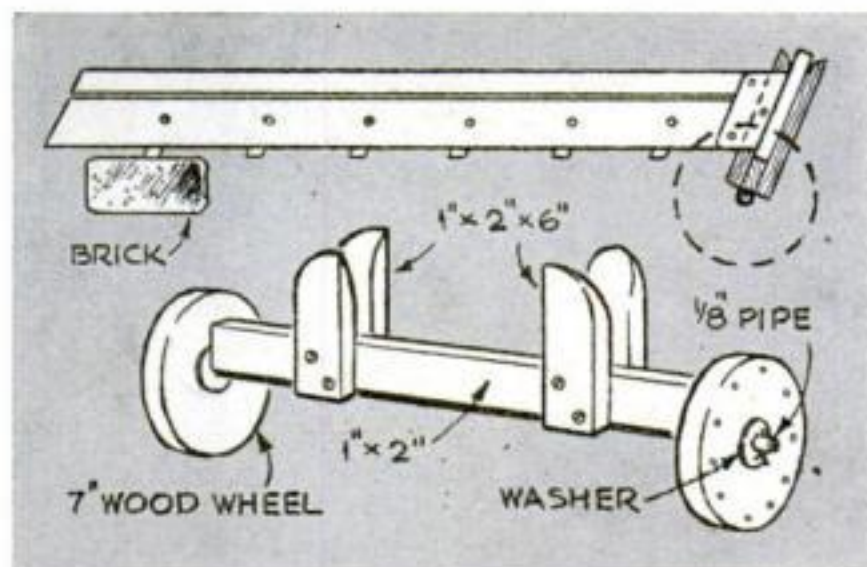
Roll Your Own Sanding Drums

YOU can make your own small sanding drums to any size by rolling strips of emery cloth into cylinders. Roll them as tightly as possible until you reach the desired diameter, then glue the end in place, and tie it with string until the glue dries. Wood screws with their heads cut off provide shafts for chucking the drums in a drill or drill press. Be sure the glued ends of the strips face away from the direction of rotation so they won't be torn loose against the work.—*Harry Wheeler, Toledo, Ohio.*



Paint Aid Saves Shop Mess

TACK a sheaf of newspapers to the edge of your workbench and they'll be handy for covering the top when you're painting or working with greasy parts. Just fold a sheet or two at a time up onto the bench and tear it off when the job is finished.—*Bil Toman, Palatine, Ill.*



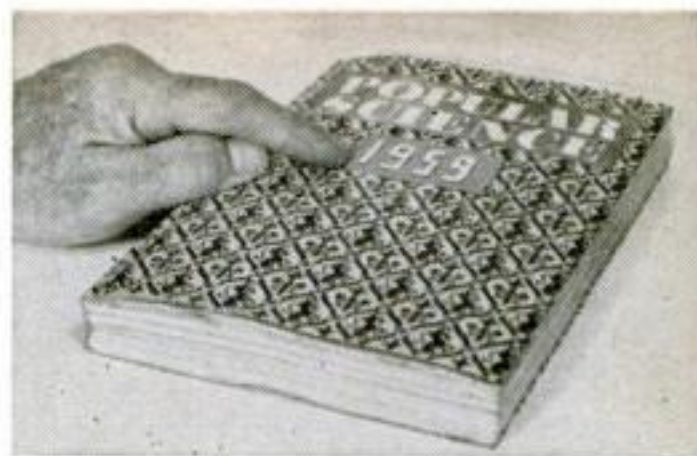
Dolly for Storing Ladder

THIS two-wheeled dolly enables me to store my 10-foot stepladder in the crawl space underneath the back porch. Each wheel consists of two disks of $\frac{3}{4}$ " wood nailed together with the grains crossing.—*David Jenkins, Xenia, Ohio.*

▶▶▶ WRAP an old piece of clean carpet around the crossarms of your saw horses to protect siding, prefinished paneling, flooring, and other wood that you especially want to keep free from dirt and scratches.—*John J. Bahr, Ithaca, N. Y.*

Here's how to go about the job of

Binding Your Own Fact Files



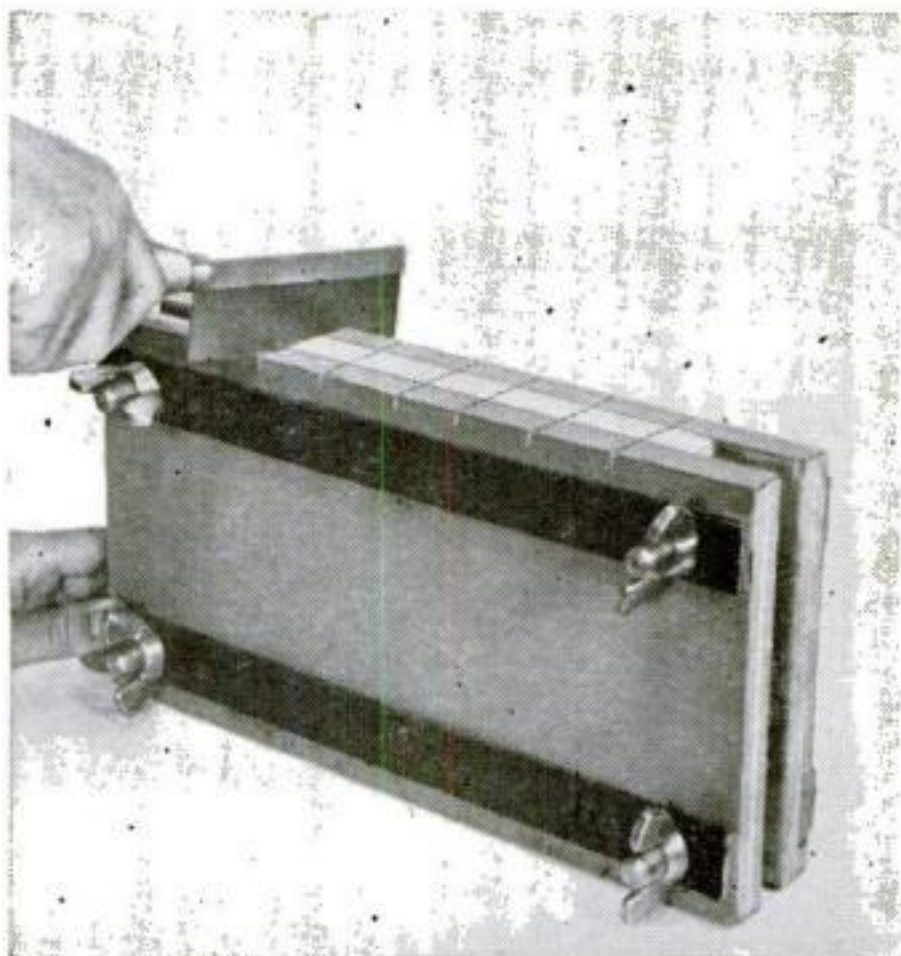
REFERENCE material should be easy to find or it's no good for reference. I bind a full year's home and shop sections of *POPULAR SCIENCE* into a single trim-looking book.

With the same method, you can sort out and bind selected material into handy files on any subject. It's a perfect way to keep catalogues, instruction sheets, and other important papers.

No stitching is required, yet a durable, professional-looking binding is produced.

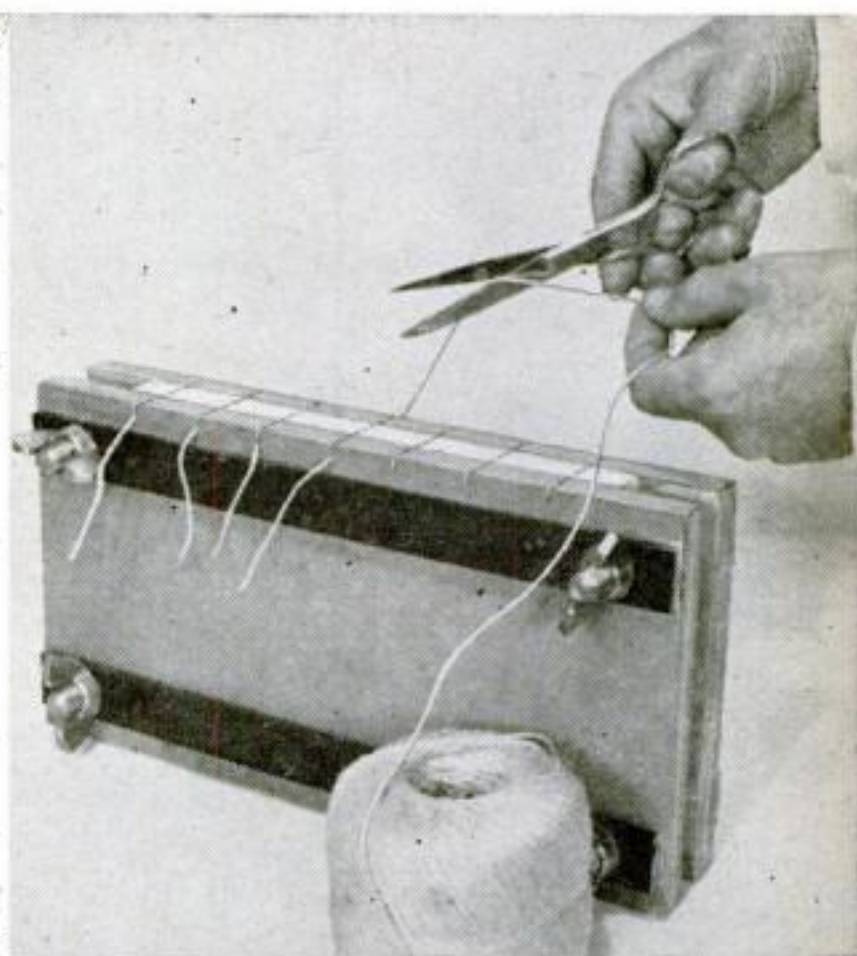
It's neat because you don't cut the pages—you merely lift out the staples in the original binding. The pages are pulled apart and arranged in any order you want. They're then stacked and clamped in a homemade press and bound with string and flexible glue.

You can do the entire job with ordinary household materials. For top results, you can also use commercial bookbinding materials available at stationery and art-supplies stores.—*Ralph Treves.*



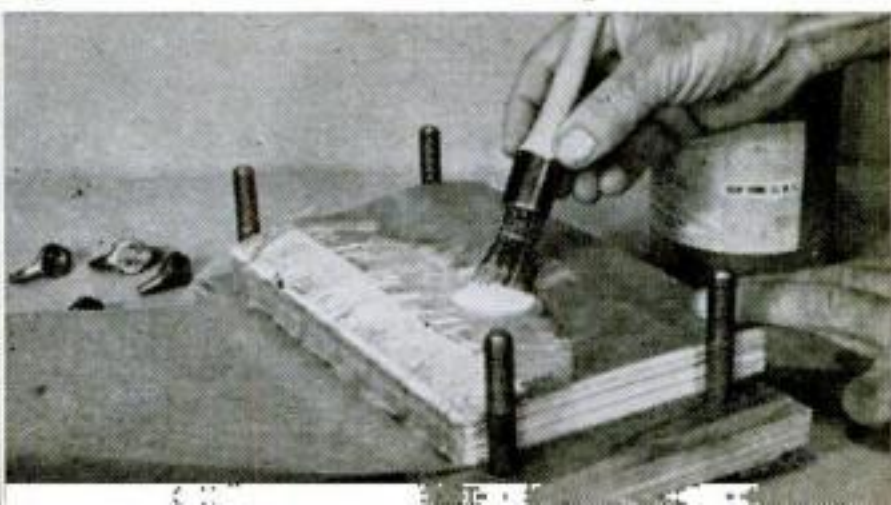
CLAMP PAGES IN PRESS made of plywood reinforced with strap iron, and $\frac{3}{8}$ " bolts and wing-nuts. After sanding off the old glue, saw $\frac{1}{4}$ "-deep notches $1\frac{1}{4}$ " apart across back of pages.

OPEN THE PRESS when glue dries and wrap buckram around back edge, overlapping each side 2". Close press and swab glue over buckram to cement it to the spine. Unravel the ends of twine so they lie flat under the buckram.



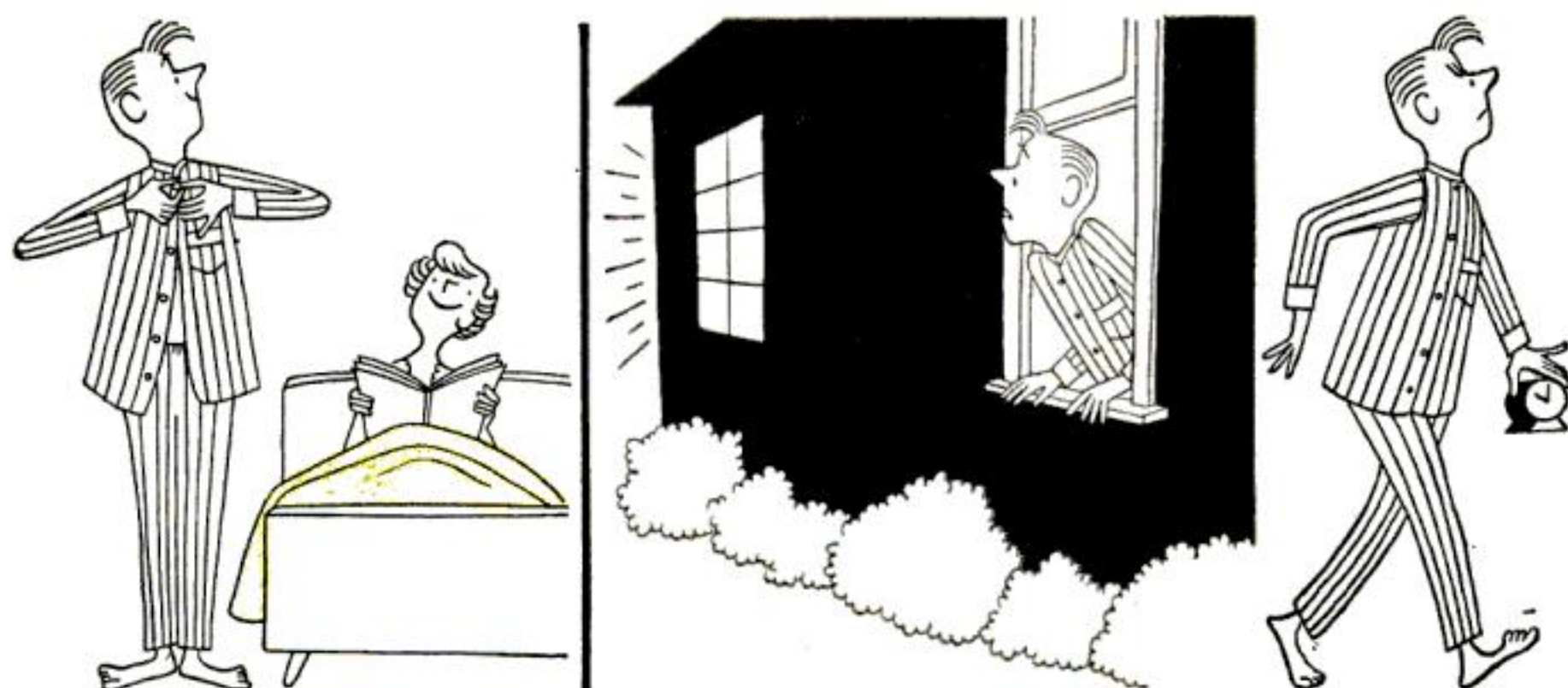
SLIP TWINE IN NOTCHES, leaving 2" overhang on sides. Brush two coats of glue on back of pages and into notches. Waxed paper over end pages keeps them from sticking to press.

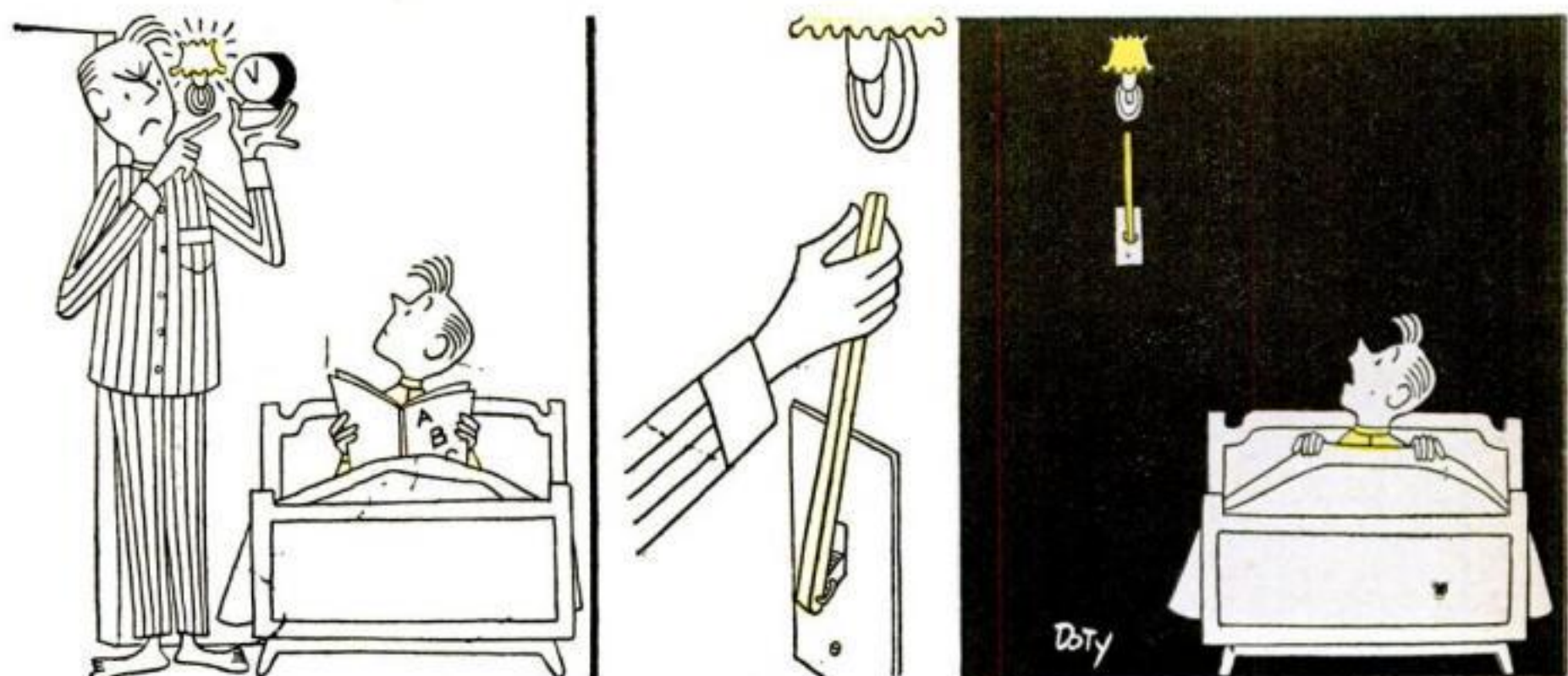
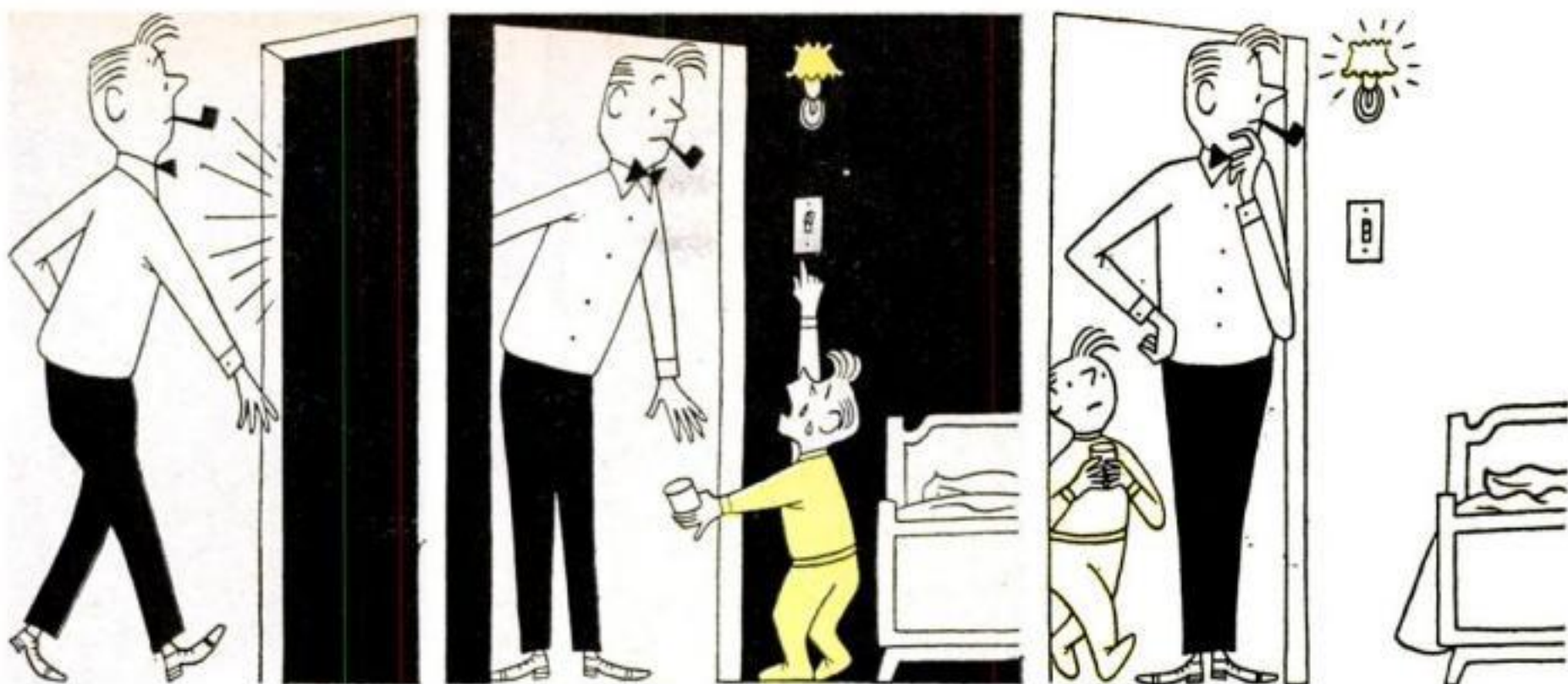
TO MAKE A HARD COVER, cement binder board or cardboard under the buckram on each side. Then pull heavy backing paper tightly around back and glue to each face. Add a final cover of plastic-coated cloth or contact plastic.



Wordless Workshop

By Roy Doty
and William Ong





From PAKISTAN:

A Homemade Radio



Professor Masoud Anwar of Gordon College, Pakistan, was disturbed because many of his countrymen in remote villages had no radios. So that they might get outside news, although lacking electricity and batteries, he designed and built this heat-powered set. After experimenting with solar cells (no sun at night) and candles (too costly), he cast about for some heat source that could be found in almost any village house. He hit on the "hookah." Here, the turbaned Pakistani on the left is shown listening to the original model of the heat-powered radio while his companion puffs a hookah to generate juice.

For PS readers—who may not have a hookah handy—Prof. Anwar gives details for making the candlepowered version.

By Masoud Anwar

A CANDLE flame powers this homemade transistor radio. Heat is converted directly into electricity by a thermal battery you can make. It's not even choosy about the source of heat. If you run short of candles you can use a cigarette lighter, alcohol lamp, kerosene lantern, or a hot coal from the fireplace.

To make the battery you'll need three yards of 38-gauge enameled copper wire, three yards of 36-gauge special thermocouple wire, a brass base from an old light bulb, and some asbestos furnace cement. "Advance" is the name of an ap-

propriate thermocouple wire made by Driver-Harris. [If you have trouble finding it, you can get enough to make two thermal batteries by sending 50 cents to McCanna Supply Company, P. O. Box 1, Tarrytown, New York.]

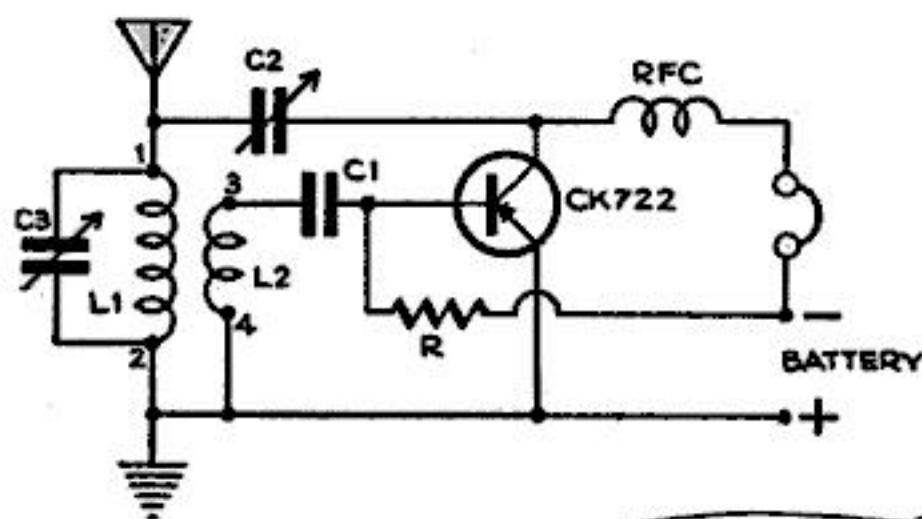
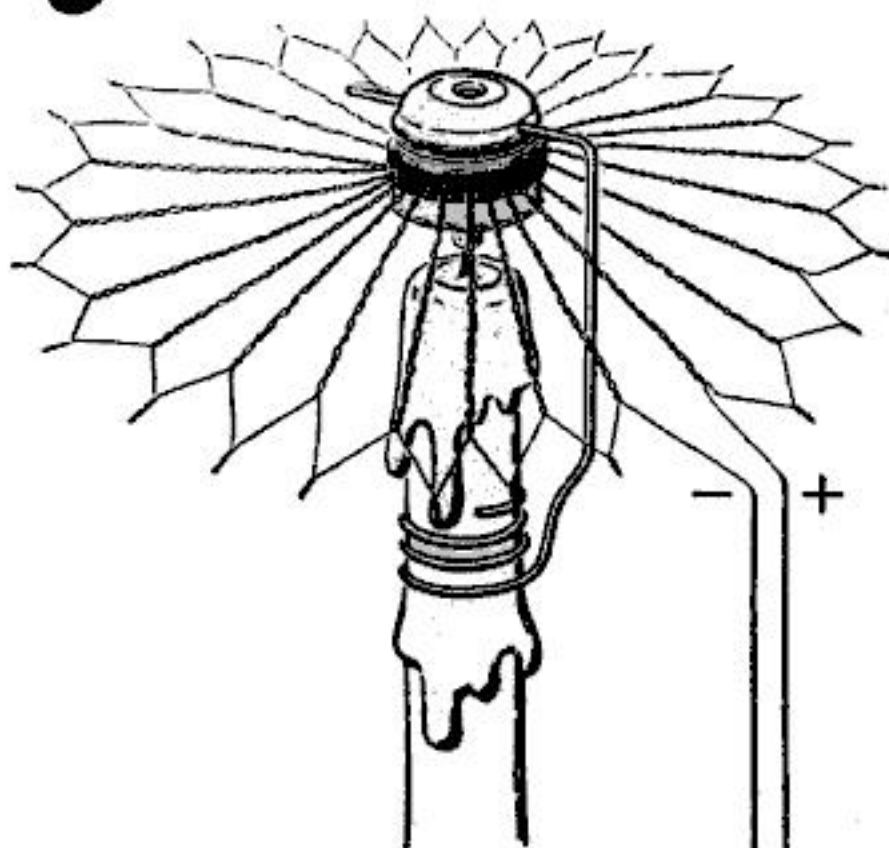
Soldering up the battery. Make up 50 thermocouple pairs consisting of 2" lengths of copper and Advance wire twisted together. Scrape the enamel from one end of the copper wire, twist it tightly around the Advance wire, and solder. Dip the soldered ends in asbestos cement and put the pairs aside to dry.

Remove the brass base from a burned-out light bulb. Clean it inside and out.

Powered by Candle

Over the small end, solder a brass or copper disk with a $\frac{1}{4}$ " hole in it. Spread a layer of asbestos cement around the outside of the base to form a collar all the way around the large end. When the cement is almost dry, place the soldered ends of the thermocouple pairs on the collar, equally spaced around the base. Bind them to the base with a few turns of thread, apply a layer of cement, and allow to dry.

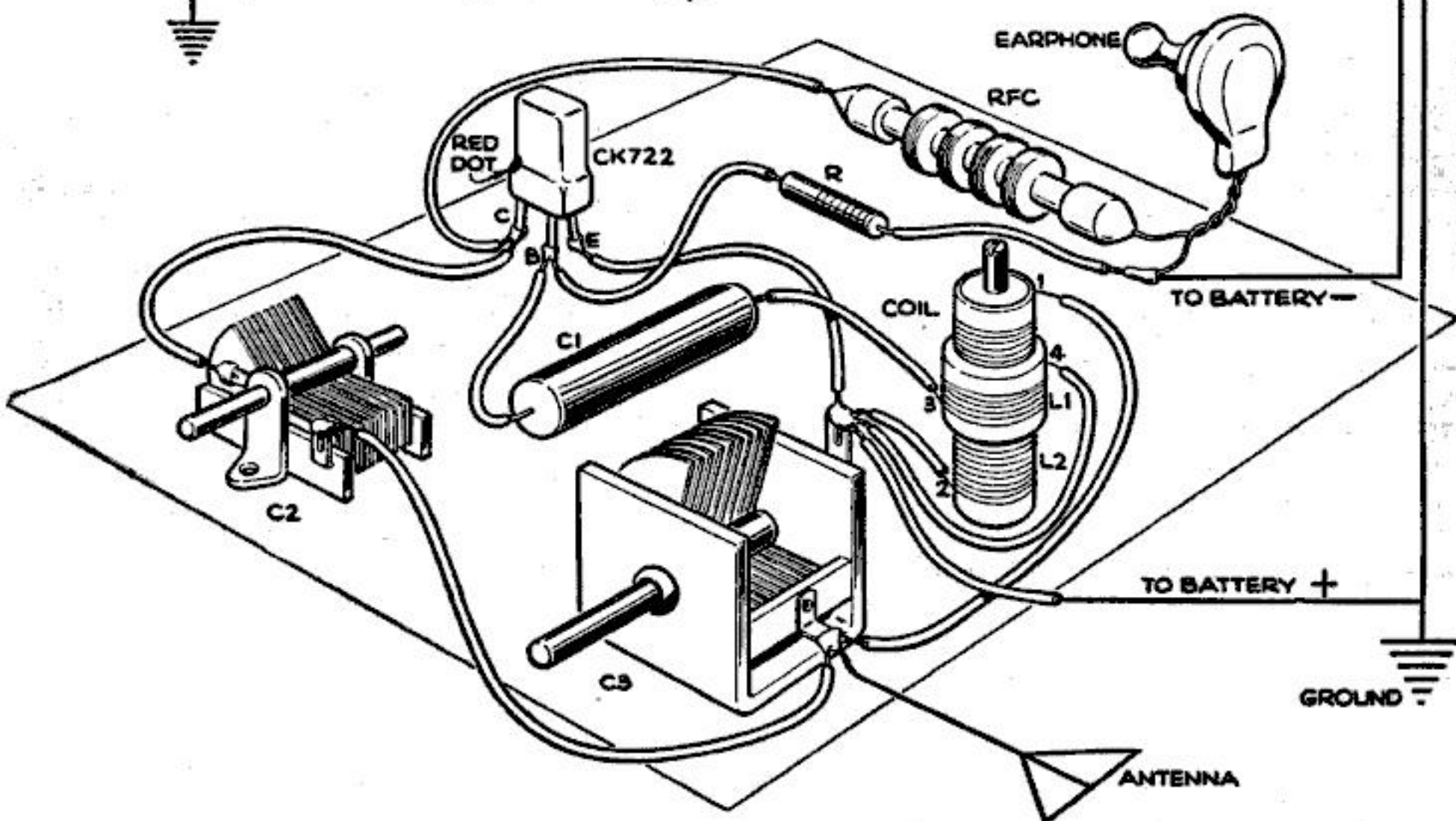
After the cement has hardened, spread the pairs of wires out spider-web fashion. Untwist the ends, scrape the copper clean about $\frac{1}{4}$ " back and connect the thermal cells in series by soldering the



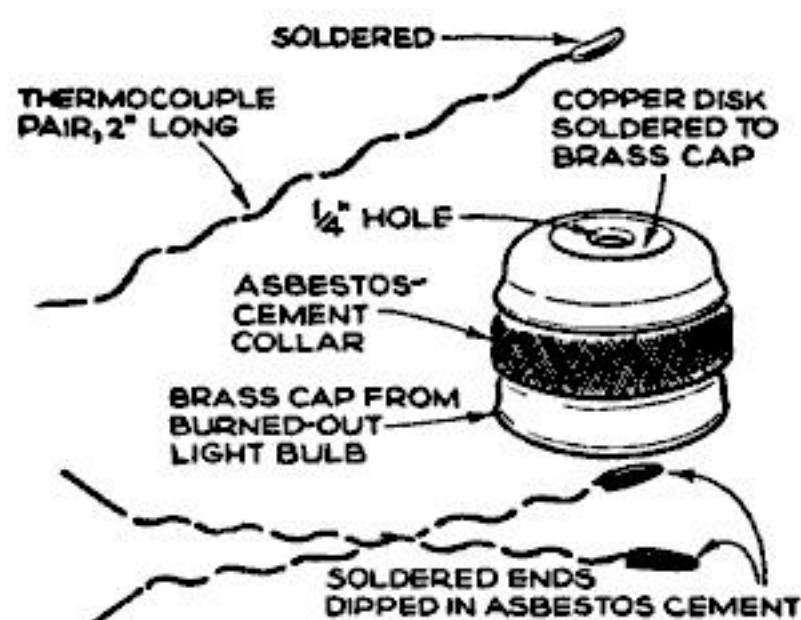
RECEIVER PARTS LIST

C1—Paper capacitor, any voltage and any capacity between .1 mfd. and .5 mfd.
C2—Variable capacitor, 100 mmf.
C3—Variable capacitor, 350 mmf. or 365 mmf.
R—Carbon resistor, $\frac{1}{2}$ watt, 47,000 ohms.

RFC—RF choke, 2.5 mh.
L1 & L2—Wound on $\frac{3}{8}$ "-diameter slug-tuned form (see text).
Earphone—High-output magnetic, 2,000-ohm impedance or better.
Transistor—CK722.



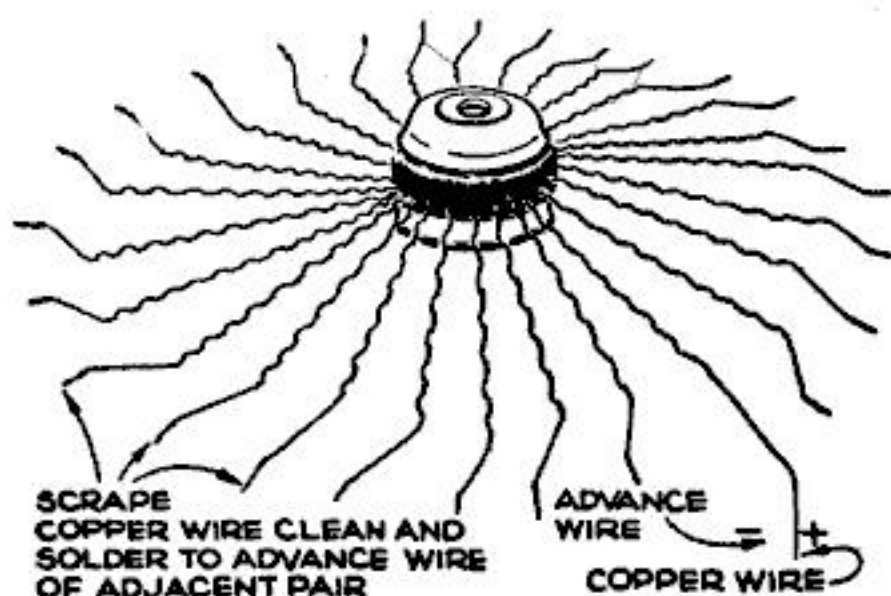
How to make the thermoelectric battery



FIRST: Make 50 individual thermocouple pairs as described in the text. Be sure the asbestos cement provides good *electrical* insulation of soldered junctions.



NEXT: Space the pairs around the cap while cement is still tacky. This will help hold ends in place while you bind them with thread and apply a layer of cement.



FINALLY: Fan out the pairs and connect them in series. Leave one copper wire and the Advance wire of the adjacent pair unjoined. These are the battery terminals.

copper wire of one pair to the Advance wire of the adjacent pair. Two ends are left over—one copper and one Advance wire. Solder a red connecting wire to the copper—this is the positive battery terminal. Solder a blue connecting wire to the Advance wire—this is the negative battery terminal.

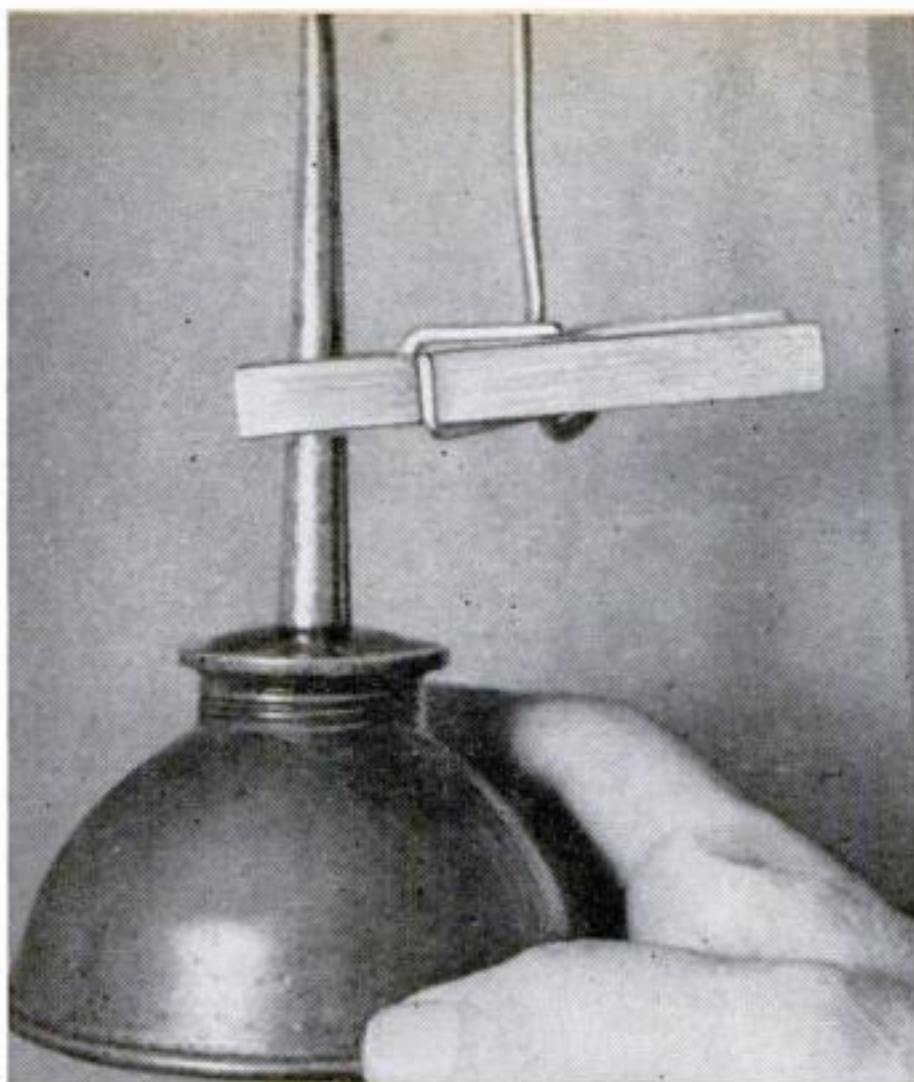
Turning on the heat. In operation, the brass light-bulb base with the thermocouples cemented to it is supported over a candle flame or other source of heat. The brass cap acts as a chimney for the flame. The ends of pairs cemented to it are the hot junctions of the thermocouples. The ends fanned out around it are the cold junctions. The thermal battery will deliver about 0.6 volts with a candle flame and a short-circuit current of 8 ma. The radio circuit is designed to work efficiently on half a volt and only 0.1 ma.

The radio receiver is a one-transistor, regenerative set. Capacitor C2 is the regeneration control. As is usual with regenerative sets, stations are tuned by turning the regeneration control knob clockwise, then rotating the tuning knob until a whistle is heard. Next, turn the regeneration knob back until the whistle just disappears. This circuit gives much better sensitivity and selectivity than the usual one-transistor radio that uses a crystal detector and simply amplifies the audio with the transistor.

Layout and packaging. This is not critical. You can wire it breadboard-style using conventional full-size parts from an old radio, or you can buy miniature parts and fit the whole works into a palm-size plastic case. The original set was built into a small cardboard box.

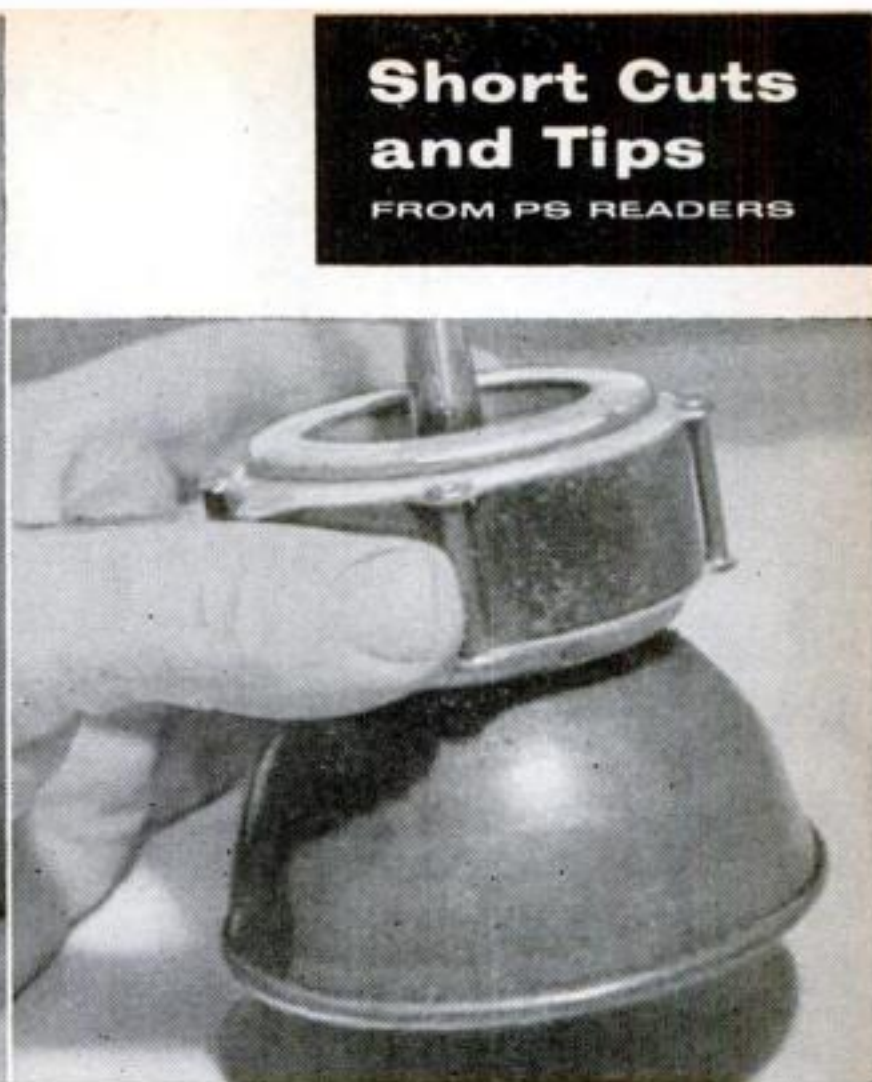
Wind coil L1 on a 3/8"-diameter, slug-tuned coil form—90 turns of 38-gauge enameled copper wire. Wrap a piece of fairly stiff paper around the center of L1 and on this wrap 10 turns of 36-gauge enameled copper wire to make L2. The turns in L2 can be varied from 5 to 10; fewer turns give better selectivity but less volume.

Adjust the tuning slug in the coil until you can tune in all stations of interest. With a 15-foot antenna, the original set covers a band from 450 to 1,600 kc. Using a 50-foot antenna, it covers from 550 to about 1,500 kc. By screwing the slug out slightly, you can tune up to 1,600 kc. when you are using the longer antenna.



Keeping an Oilcan Handy

YOU'LL always have oil right at your drill press if you attach one of these can holders to it. The one at left is merely a stiff wire hooked through the eye of a clothespin spring. The upper end can



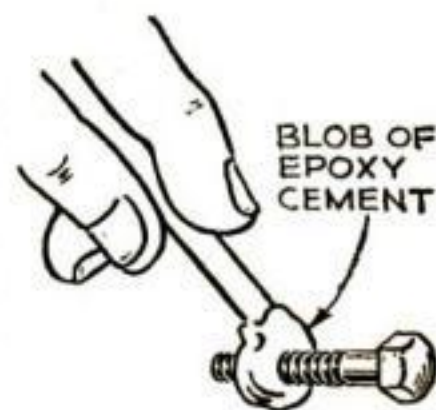
Short Cuts and Tips

FROM PS READERS

be fastened to the drill-press housing. The other is a ring-shaped permanent magnet salvaged from an old TV picture tube. Wall-mounted or bracketed to the machine, the magnet will hold any household oilcan securely.—*Glen F. Stillwell, Manhattan Beach, Calif.*

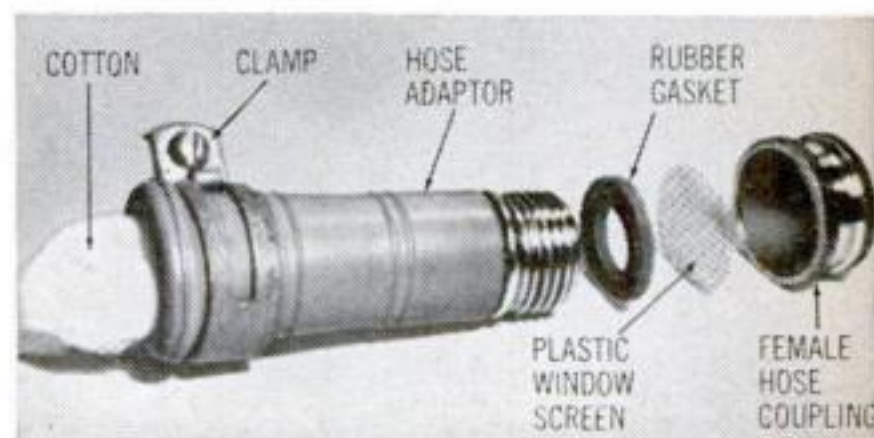
Improvised Nut from Epoxy Cement

WHILE repairing an appliance, I lost one of the odd-sized nuts that held the case together. I made an on-the-spot replacement by oiling the bolt and putting a blob of epoxy cement around the threads. Heated with an infrared lamp, it dried in five minutes. I turned it off the bolt and filed it square. It holds wherever finger tightening is enough.—*Stephen N. Stresnic, Ft. Lauderdale, Fla.*



Magnetic Grip for Screwdriver

STARTING a screw in a hard-to-get-at spot is tough unless you have a driver with a special grip. Your standard screwdriver will hold screws tightly if you sandwich the blade between bar magnets, like those for kitchen bulletin boards.—*H. J. Gerber, Stillwater, Okla.*



Water Filter for Darkroom

You can make an efficient photographic water filter from a rubber adaptor—the kind that attaches a hose to a non-threaded faucet. Use the hose clamp only if the assembled unit slips off the faucet every time you turn on the water.—*Robert Micals, Freehold, N. J.*

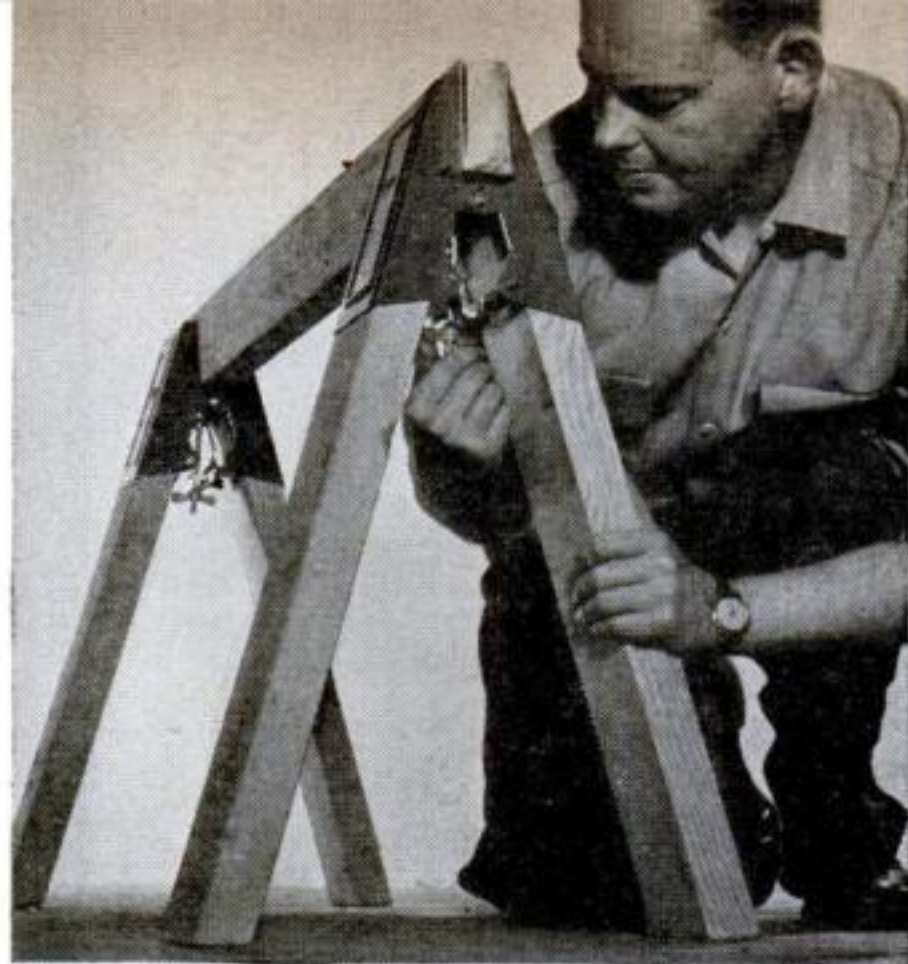
5 Ways to Make Sawhorses

By John Burroughs

WHEN you're using portable power tools you generally need portable work supports. Not a bench, but a pair of low, rugged move-aroundable sawhorses. Few pieces of shop equipment are more useful.

Easiest to put together are sawhorses built with commercial metal fittings. Several kinds of fittings are available. These horses have the advantage of knocking down readily for transport or storage. And the two-by-four rails are easily replaced when they become chewed up.

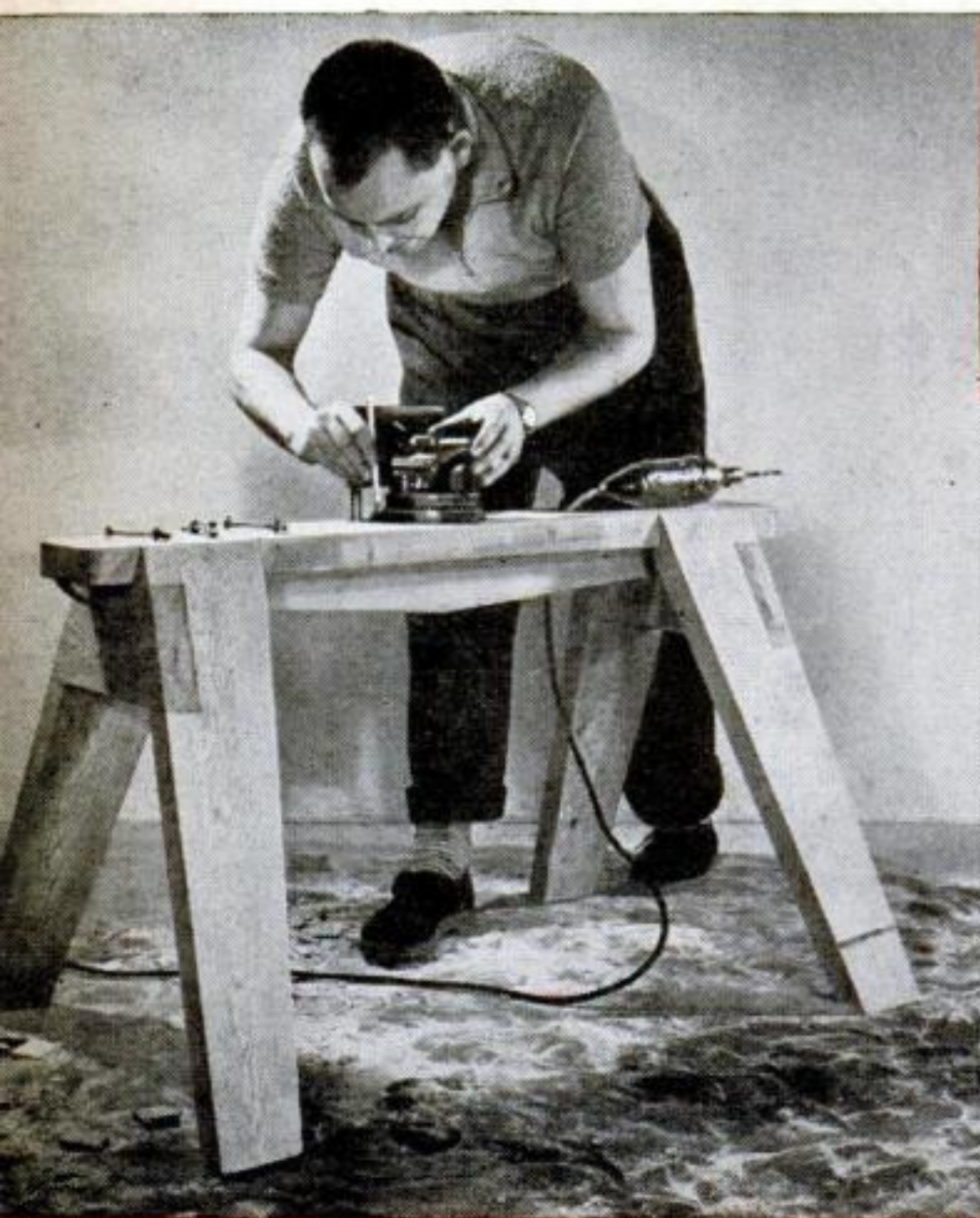
Shop-built horses usually are all lumber. There's one exception—the demountable, pipe-leg horse, which is a good bet for the guy with no permanent shop space. A-frame construction—with cleats fastened across the legs to support the rail—is the most common all-wood horse.



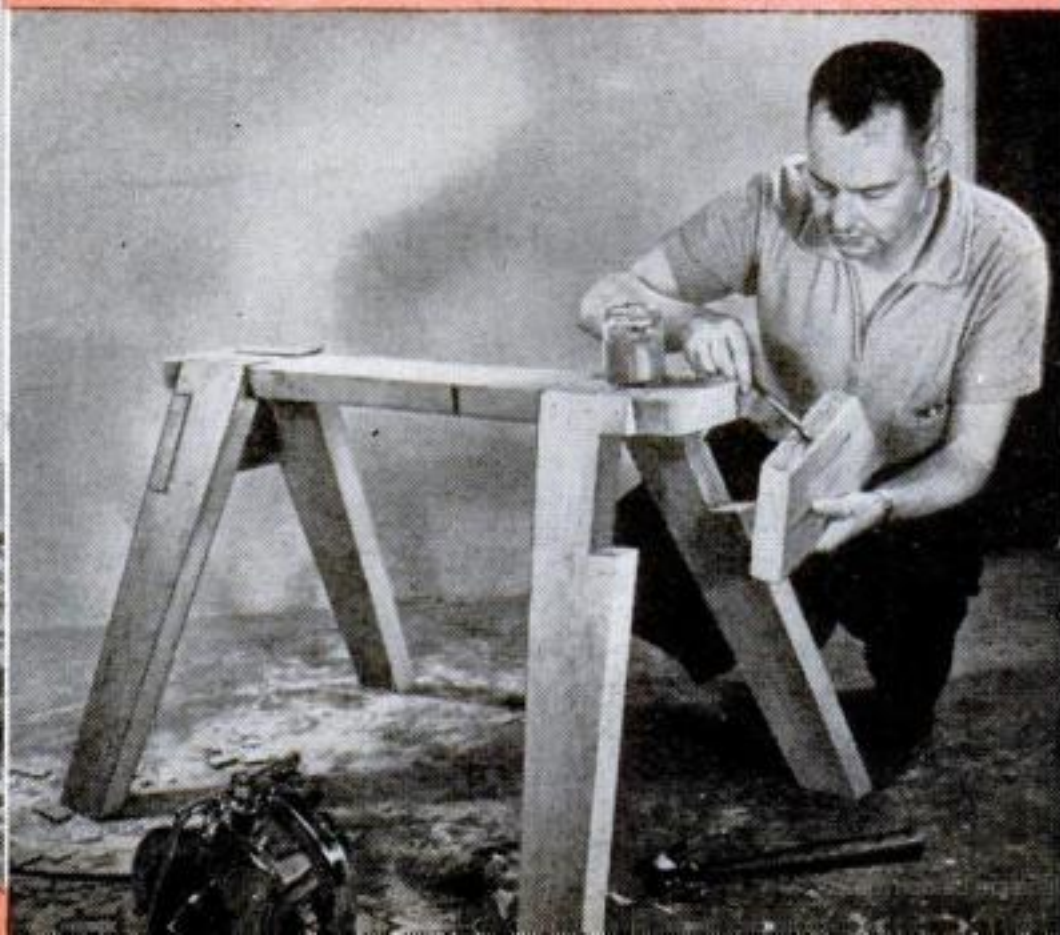
STEEL BRACKETS can be used to turn five lengths of two-by-four into a sturdy horse. Type shown (about \$3.50 a pair) has clamping screws to secure legs.

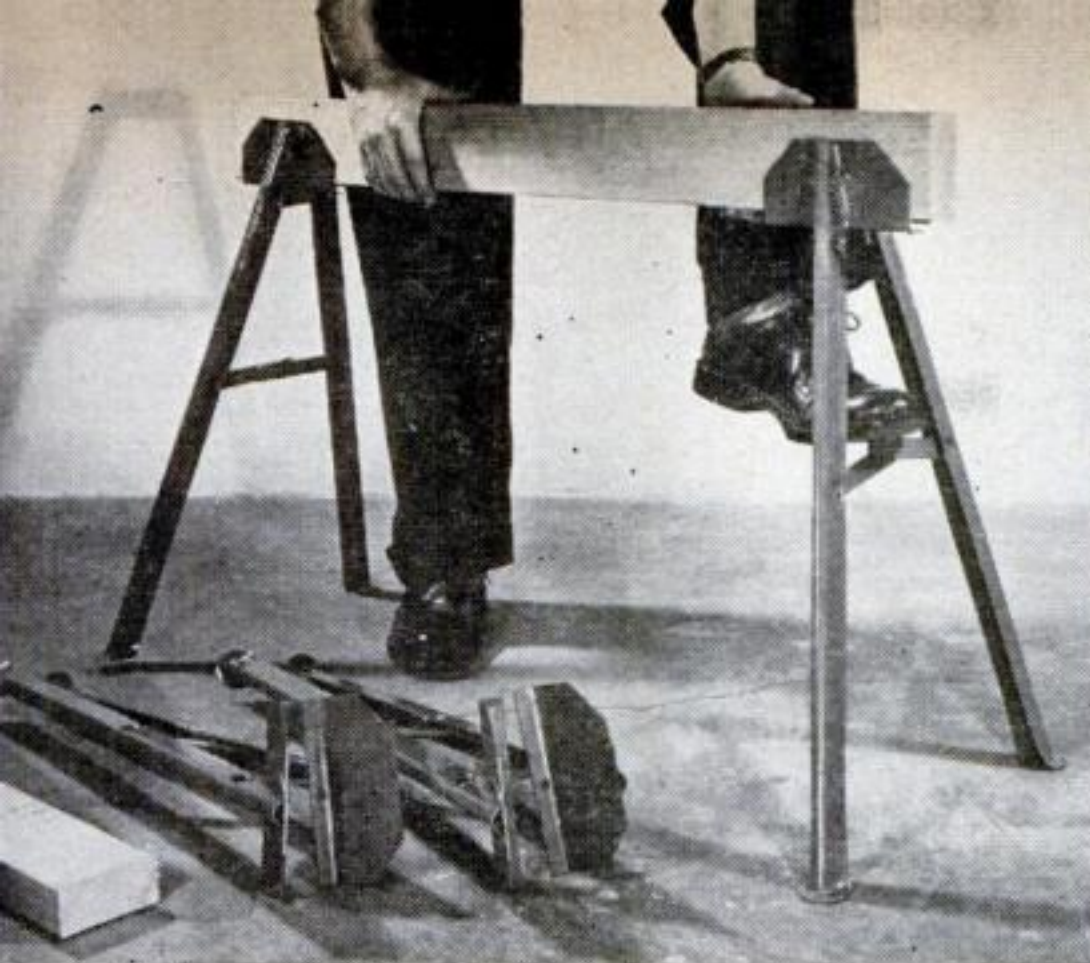
But with heavy use, a light, nailed-together horse develops the shakes.

A safer, more solid, longer-lasting A-frame horse results if you notch together the legs, rail, and cleats like the pieces of a Chinese puzzle—and cement the structure together with a paste of epoxy resin and fine sawdust. The notched-in joints needn't be accurately cut, since the paste is both adhesive and filler.

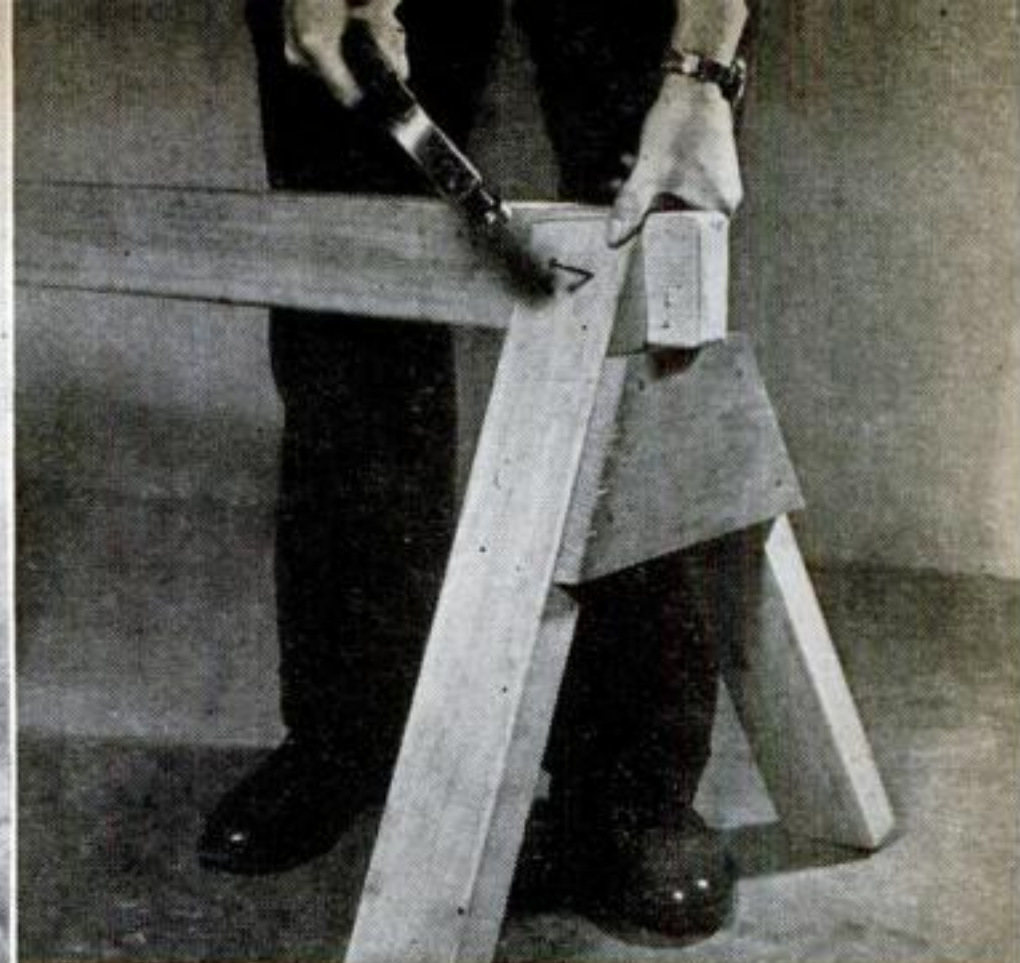


THIS ONE'S BUILT TO LAST. A two-by-six rail reinforced with a two-by-three web is supported by two-by-six legs tapered to 3 $\frac{3}{4}$ " at the bottom. End cleats, also two-by-six, are set in notches cut in legs, and permanently secured with a mixture of epoxy glue and fine sawdust. Though you can't knock them down for storage, they'll nest compactly when stacked.





TONG-LIKE LEG ASSEMBLIES can be locked onto a two-by-four and knocked down in an instant. They'll support heavy loads, but may be wobbly on level floors. Cost: about \$4 a pair.



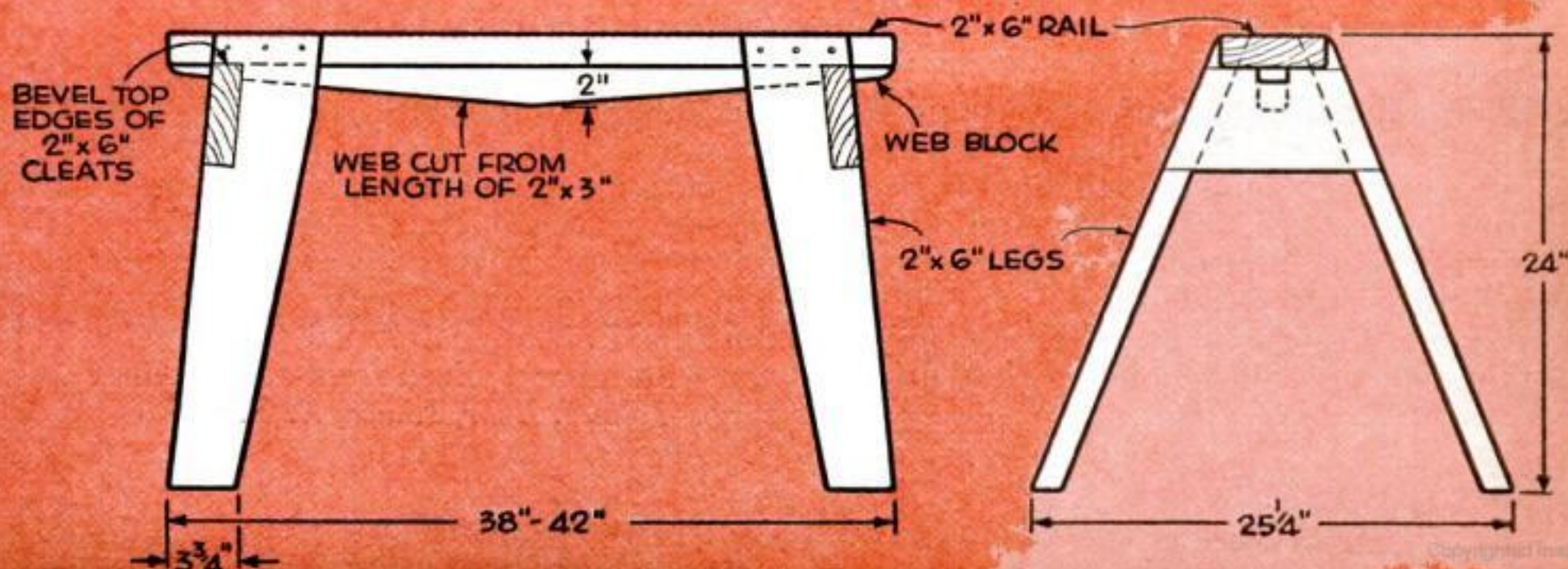
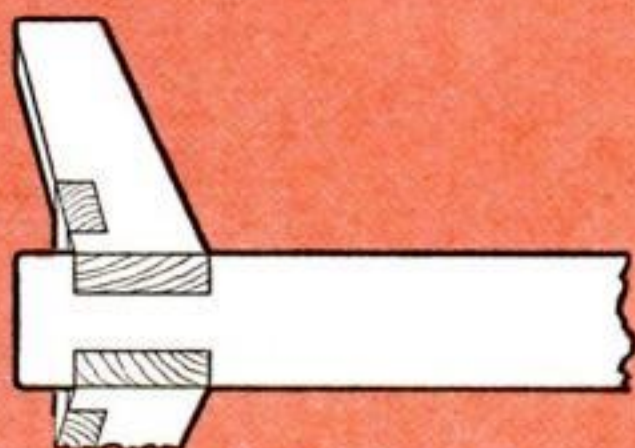
OLD-FASHIONED A-FRAME SAWHORSE has legs mitered and nailed to rail. End cleats add reasonable rigidity. While easy to bang together, such horses soon become rickety.

When using epoxy-sawdust, mix only small quantities at a time. Some epoxy formulations when mixed in large batches generate considerable chemical heat. The heat accelerates curing, and the mass may set up before you're able to use it.

Rake the resin-bedded joints off flush with a coarse-grit sanding disk. Then, if you wish, glue a web cut from a two-by-three under the rail to add rigidity.



PIPE LEGS are easy to dismantle. Screw caps on 24" lengths of $\frac{3}{4}$ " pipe and use metal-filled epoxy paste to bed the caps in recesses chiseled in the rail. Legs can then be unscrewed. Fit leg ends with rubber crutch tips to save floors.

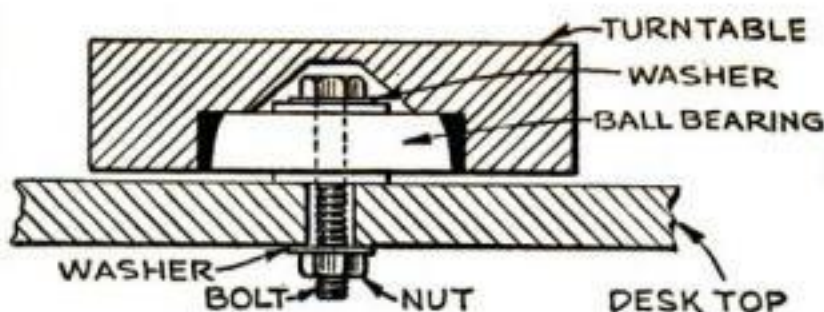


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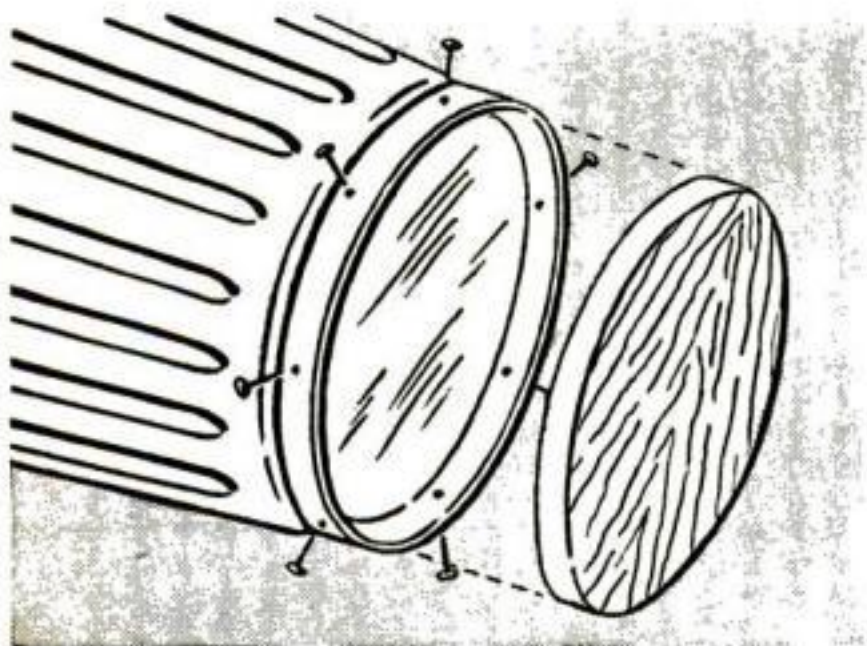
Phone Turntable Keeps Dial Handy

A FRIEND of mine—a busy executive—complained of having to wrestle his phone back into place each time a visitor made a call from his office. I installed this turntable on his desk so that the phone can face whoever's dialing—without any struggle. I bolted the inner ring of a ball bearing to the desk top and recessed the outer ring into the bottom of a $\frac{3}{4}$ " panel of plywood cut just large



enough to support the phone base.—
R. Stille, Petrópolis, Brazil.

▶▶▶WHEN pouring new concrete near existing masonry, it's best to protect the old surfaces from splashing. Make a paste of soap chips or detergent and brush on a coat. When the new concrete has set, hose the soap paste off the old masonry. The cement spatters will wash away, too.
—*John P. Shuler, Canoga Park Calif.*



Strengthening a Trash Can

METAL garbage cans often get such rough handling that the projecting bottom rim becomes bent and the can won't sit straight. You can stiffen this flange and protect the raised bottom from denting or puncture. Cut a wood disk that will fit snugly inside the rim and fill the recess. Fasten it in place by nailing through predrilled holes in the flange.—
Arthur S. Green, Chicago.



Putty Hitches a Ride

WHEN you mount that ladder to paint the upper siding, spare yourself the exasperation of having to climb back down for puttying supplies. You're sure to find some overlooked cracks and nail holes up there, so go prepared on your first trip. Take along a small container of putty and a knife, strapped to the paint can with a band sliced from an old inner tube.—*John J. Bahr, Ithaca, N. Y.*

My PRIZE project is ...



...a sailing clipper ship

THIS giant replica sails as beautifully as her famous real-life original, the clipper ship *Young America*, built in 1853. The model is 6' long, stands 4' high to her mast tips, and weighs 45 pounds. It was necessary to weight the keel with 22 pounds of lead for ballast, but she'll take a stiff blow without heeling. She was built in three months.

VINCENT VENZA SR.,
Nutley, N. Y.

...a windmill weather vane

The slightest breeze from any direction whirls the blades on my 4'-tall model of a Dutch windmill. The tower top of the mill is a ball-bearing turret that turns freely with the wind, acting as a weather vane. The blades have a 5' span. The shingled effect on the sides was made by slicing hardboard into 2" strips and overlapping them like real shingles.

ARTHUR E. ASHTON, Ludlow, Mass.



...a cab-over-engine jeep

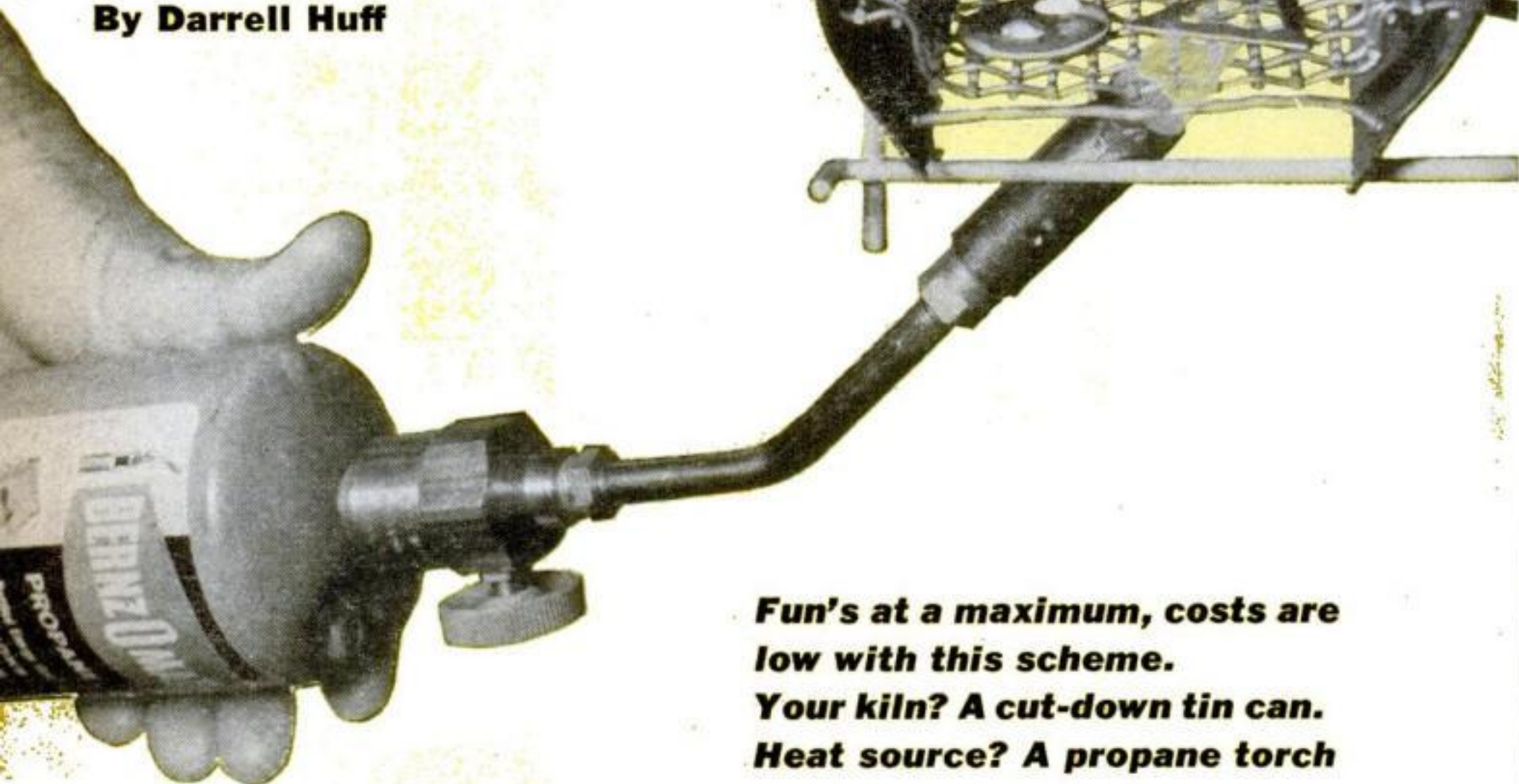
THE starting point was a '47 jeep with four-wheel drive. After removing the body, I installed a 1945 Ford truck cab and a 1953 Nash hood with customizing touches of my own. Finishing is a two-tone enamel job, and the result is a snappy cab-over-engine pickup.

JOHN P. KRZEMIEN,
Gowanda, N. Y.



Copper Enameling with a Torch

By Darrell Huff



Fun's at a maximum, costs are low with this scheme.

Your kiln? A cut-down tin can.

Heat source? A propane torch

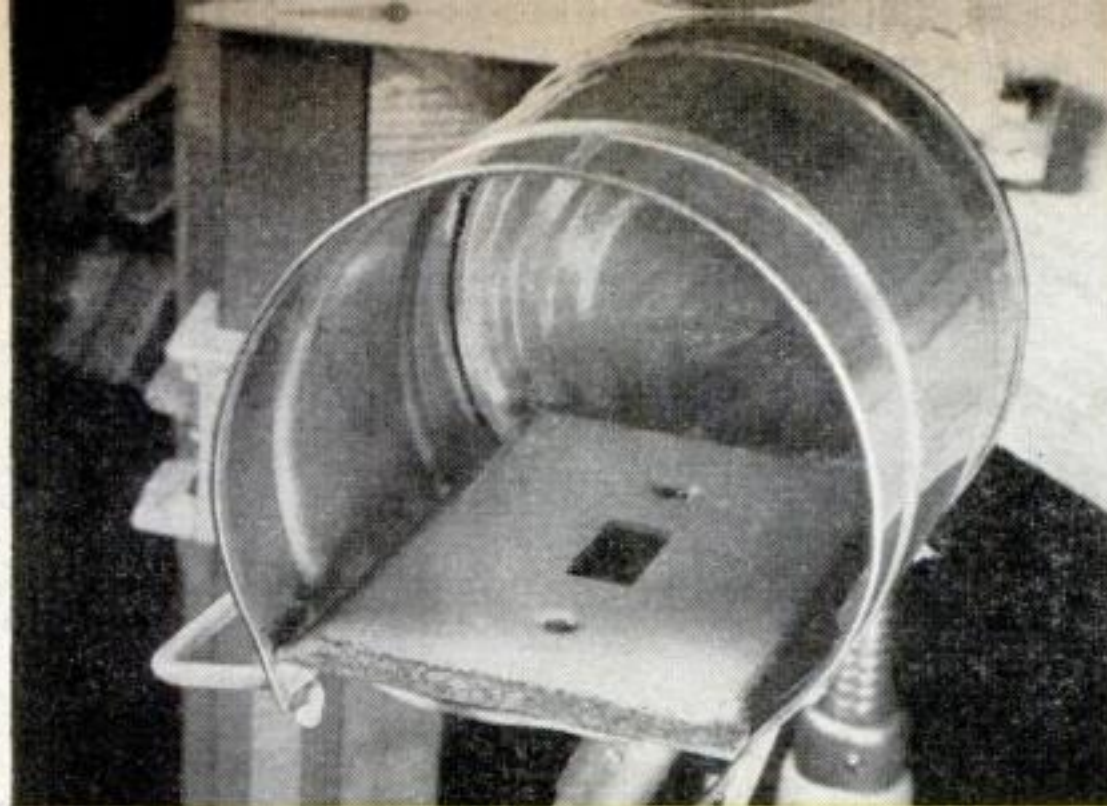
YOU don't need an expensive electric kiln to custom-craft your own enameled jewelry and household accessories. Just buy a few bottles of colored glass powders and some copper blanks. Blanks are available in many shapes—for earrings, cuff links, furniture knobs, matched tiles, fishing lures, to name a few—or you can cut your own from sheet copper.

To fire the pieces (so that the dust-fine grains of glass fuse into a solid baked-on coating), make the reflector oven as shown in the sketch. When you apply the flame of an ordinary propane torch to the underside of the blanks, the

can retains and concentrates the heat.

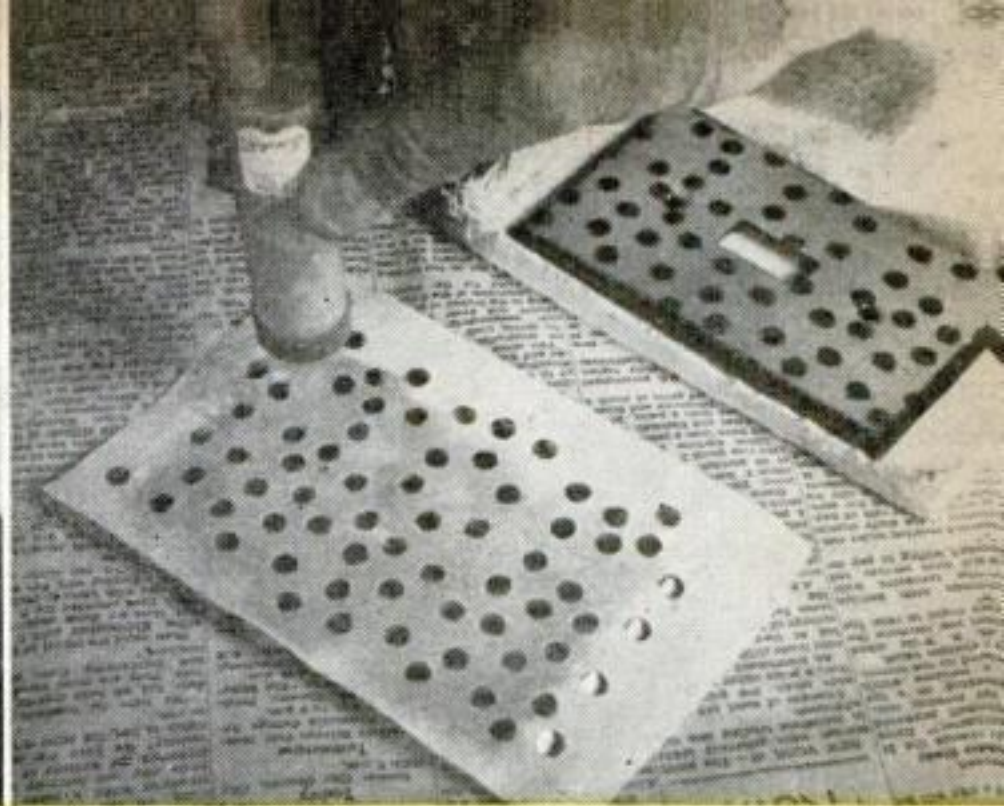
First, clean the copper surface. Kitchen cleanser will do. Rinse and wipe dry, taking care not to touch the surface. Sprinkle on an even coat of enamel and lift the blank into the oven with a spatula or putty knife. Heat from below with a torch adjusted for its strongest flame. Keep it moving slowly so that heat is evenly applied. When the copper glows red and the enamel flows glassy-smooth on the surface, remove the torch. Let the blank cool in the oven.

Designs are added by refiring after applying a contrasting color of powder. Glass threads or lumps can also be used.



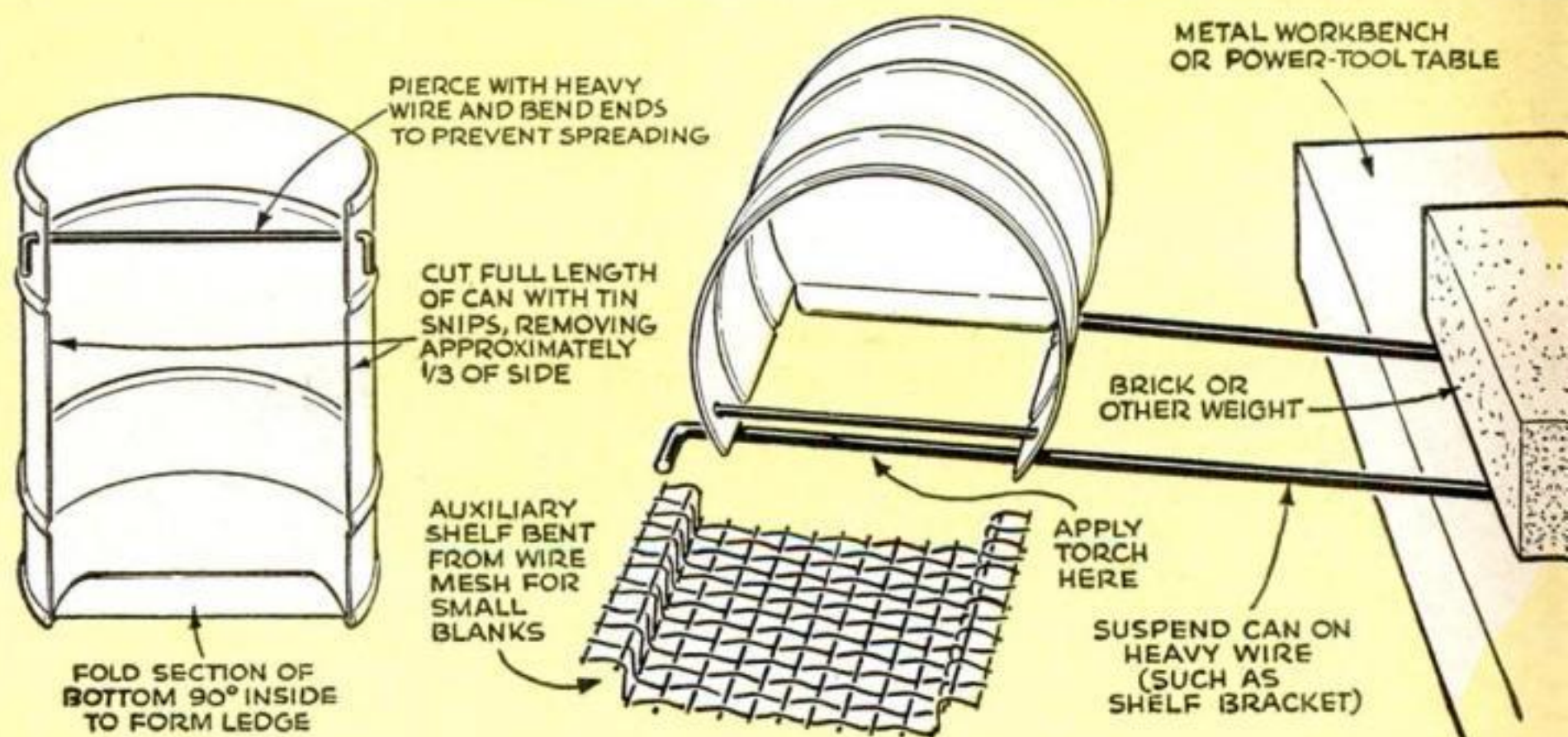
ENAMELED SWITCH PLATES add a touch of color to your home. If you scale your oven to accommodate the heavy copper blanks, they'll rest on the wire brace and rear flange of the can.

SGRAFFITO IS THE TERM for scratching designs through loose powder. This plate was first fired with clear flux so that pattern of international driving signs would appear in gold.



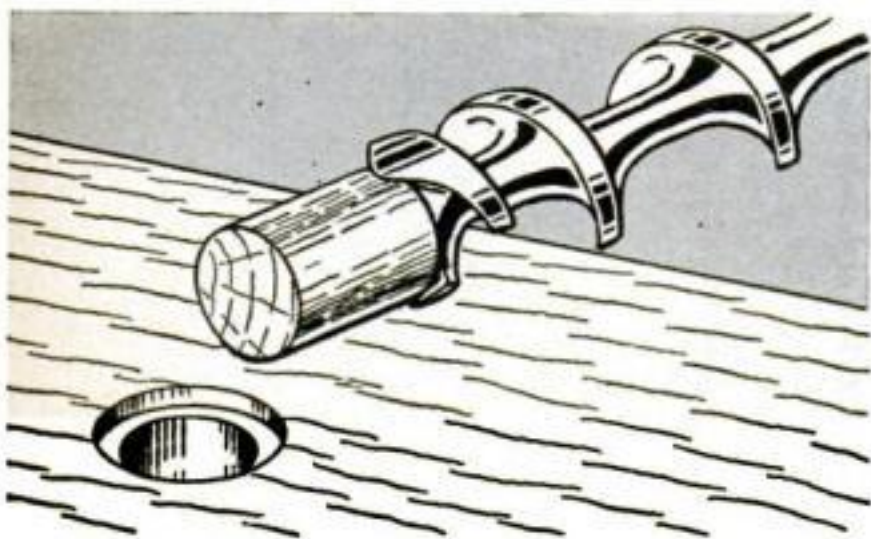
A SECOND COLOR can be added after the base coat has been fired. One way to apply the design: Sprinkle powder over a stencil before refiring. A paper punch made this one.

DECORATIVE OUTLET PLATES are similarly made. Blanks are about 60¢ each from The Copper Shop, 1924 Euclid Ave., Cleveland 15, or from Thomas C. Thompson Co., Highland Park, Ill.



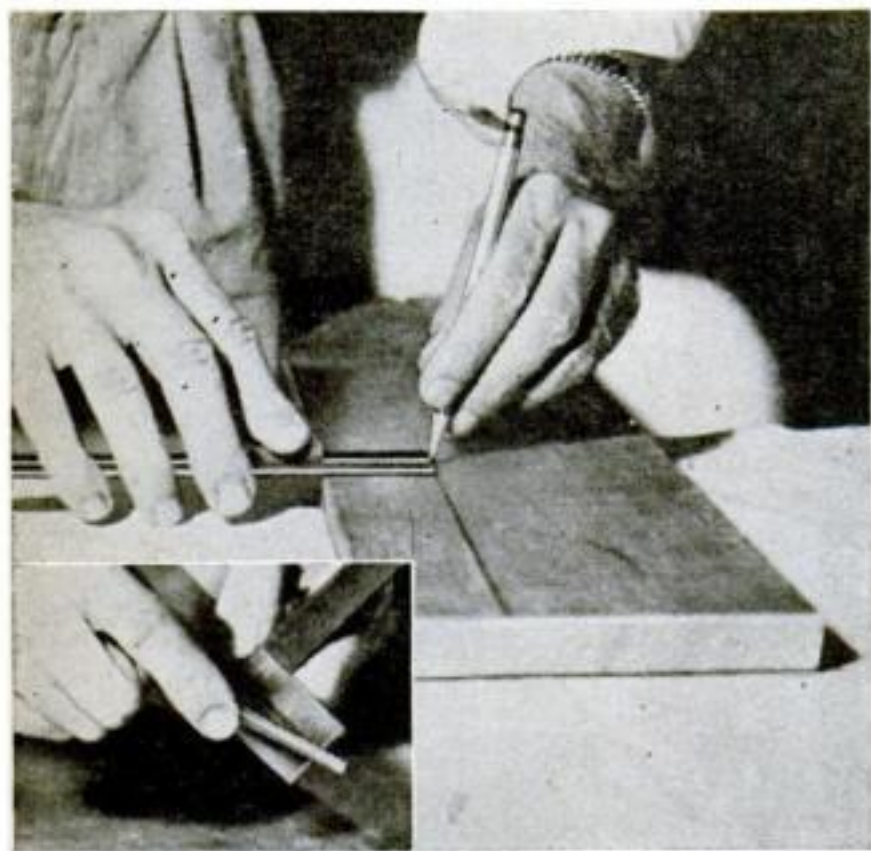
Short Cuts and Tips

FROM PS READERS



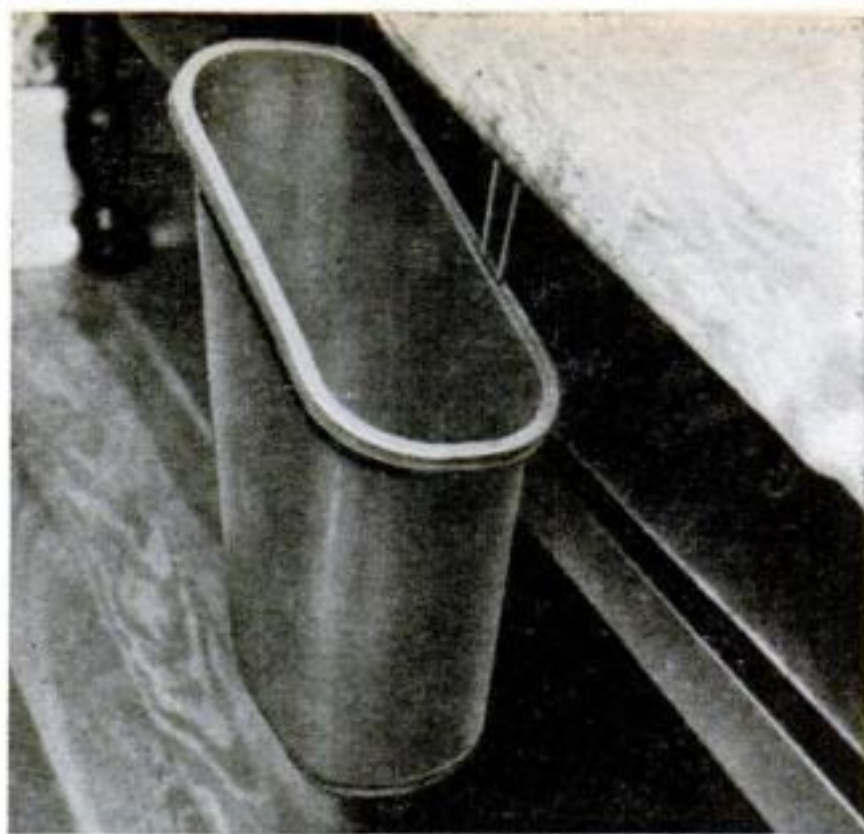
Dowel Plug Guides Bit

A USEFUL guide for counterboring—or for rebor-ing holes to a larger diameter—is a short length of hardwood dowel with the same diameter as the original hole. In one end, drill a pilot hole $\frac{1}{4}$ " deep and half the maximum diameter of the bit's lead screw. Turn the guide onto the screw by hand and insert it in the hole.—*Daniel Bousha, Jackson, Mich.*



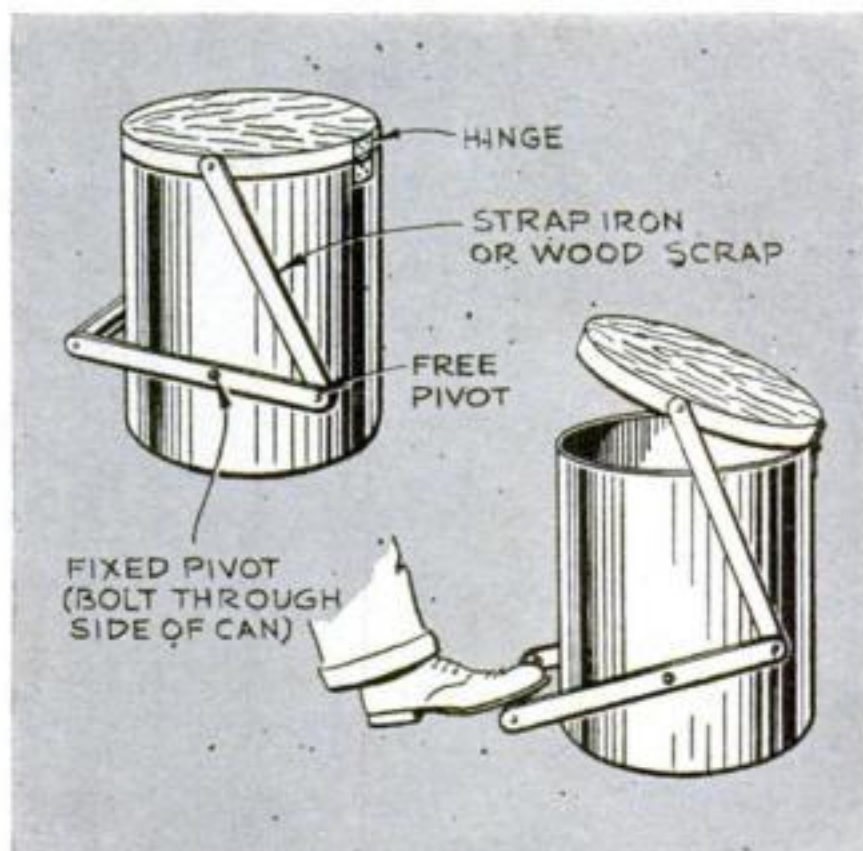
Notched Square Is Marking Tool

WITH a triangular file, notch the end of the blade of your combination square. When you want to mark a board for a cut paral- led to one edge, adjust the square to the width you want and clap it against the edge. By sliding it along the board with a pencil point held in the notch, you'll make a perfect layout.—*E. M. Har- man, North Hollywood, Calif.*



Bedside Wastebasket

LITTER baskets designed for use in automobiles are also handy in the sick room. Most of them are provided with a hook for hanging, so they'll attach to the frame of the bed. This keeps them with- in easy reach of the convalescent—unlike regular wastebaskets that have a way of straying beyond reach from the bedside.—*Wayne Floyd, Fayetteville, Tenn.*



Foot-Operated Refuse Lid

YOUR workshop needs a covered con- tainer for oily rags and other refuse. A lid that lifts when you step on a pedal saves fumbling, but kitchen cans of this type are usually too small. You can con- vert a good-sized barrel by hinging a wooden disk to it and bolting on the simple lever mechanism shown above.—*R. Stille, Petrópolis, Brazil.*

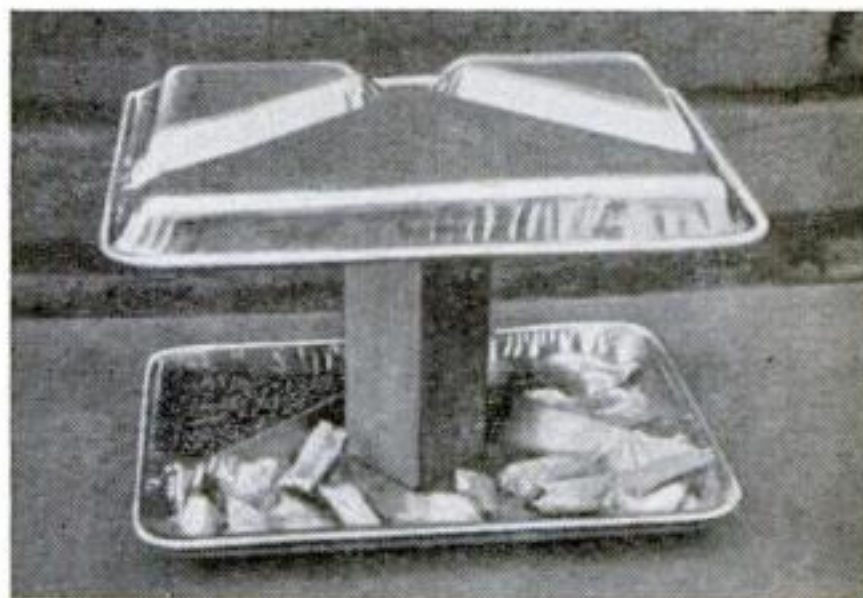


Darkroom Wall Pockets

GROPING on shelves for bottles of photographic solutions can bring disaster in the darkroom. It's handier to store these bottles in tip-proof wall pockets made by cutting down dry-chemical cans with tin snips. Tape the exposed edges of the cans to protect your fingers.—*Wayne Floyd, Fayetteville, Tenn.*

Short Cuts and Tips

FROM PS READERS



Winter Snack Bar for Birds

A SHELTERED bird feeder can be made by nailing a frozen-dinner tray to each end of a 7" two-by-two. The three compartments are ideal for sand, bread crumbs, and seed. The sand weights the feeder and provides grit for the birds when the ground is covered with snow.—*John Mihalick, East Liverpool, Ohio.*



What Would You Do ?

... if you had no place
to park your
hammer between swats

A CARPENTER finds a hammer loop almost indispensable. But a guy like you, working in ordinary clothes or wearing a nailing apron, lacks that advantage. So...run a loop of wire through holes near the seam of your apron or work pants. Bring each end of the wire through a button and secure it with a final twist. Presto: a parking place.

*Darrell Huff,
Pacific Grove, Calif.*

Planked Projects



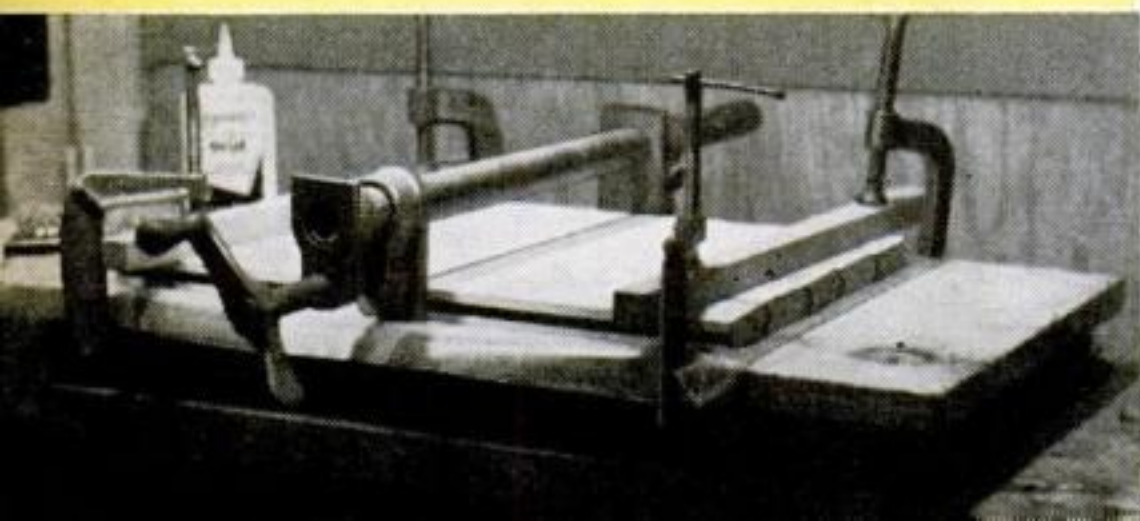
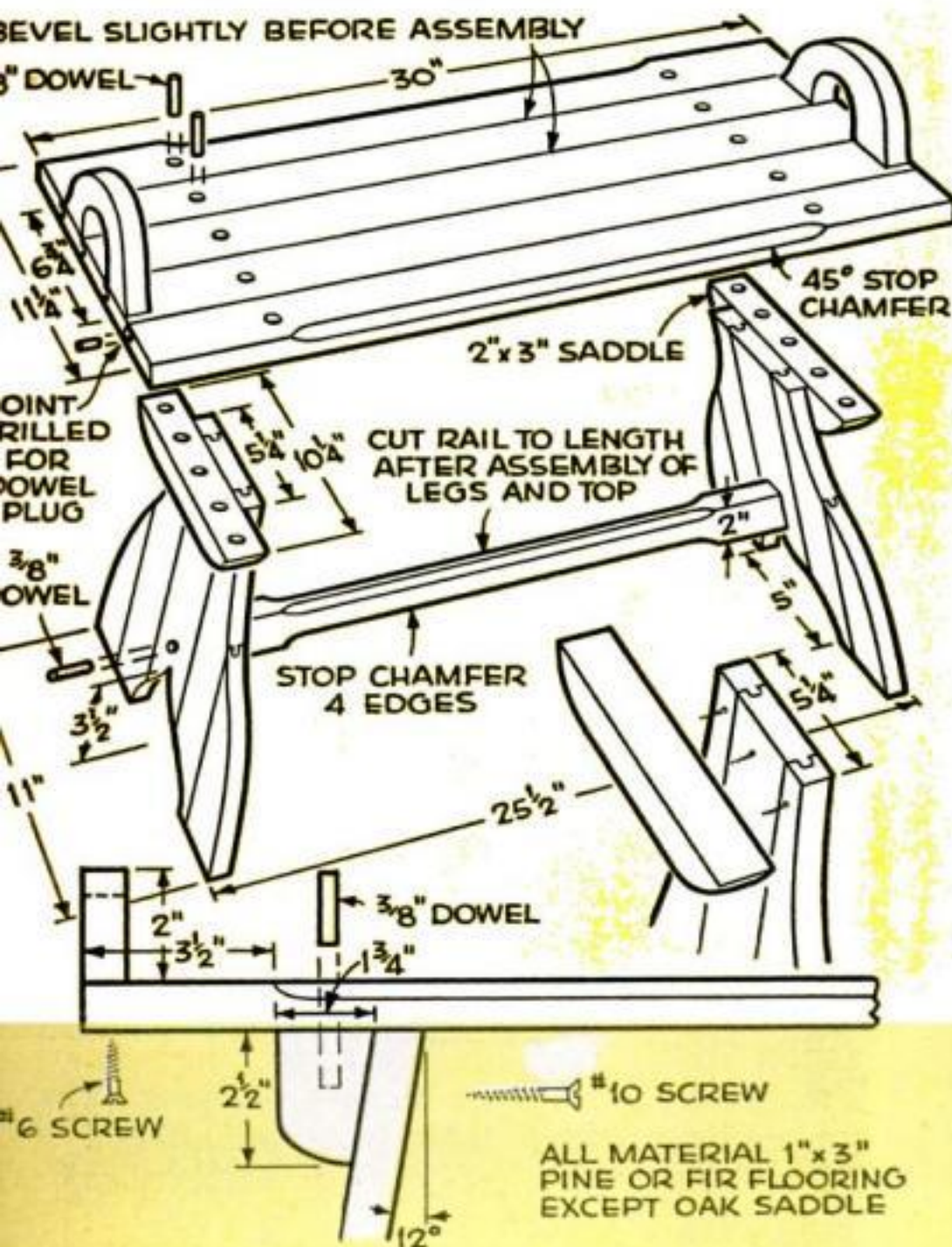
By James M. McKinney

BEFORE starting on your next woodworking project, consider the use of ordinary flooring as your material. Although not suitable for every job, it can be used successfully for a great variety of projects. It's available in several thicknesses, widths, and grades, and in a wide range of woods. It has to be—and is—splinter-resistant and warp-free, particularly in the more expensive edge-grain (softwood) or quarter-sawn (hardwood) types.

Where projects require glued-up panels or a planked effect, flooring's tongue-and-groove edges are a real boon. For comparable strength with ordinary lumber, you'd have to dowel the edge joints.

Economy is also a consideration. The wide sale of fir, pine, and oak flooring in the 1"-by-3" size (used for the two projects shown here) assures availability and lowers the price. For the same quantity of select white pine, you could pay up to twice as much, depending on local conditions. Try one of these projects. It may suggest other places you can substitute flooring for standard lumber in your shopwork.

Fir and pine are particularly appropriate for Early American effects. Least expensive of all wood flooring, these softwoods work easily and take a variety of finishes. The hardwoods are available in fewer sizes and usually have a hollow or grooved



CLAMP GLUED-UP PANEL to flat surface, using waxed paper or aluminum foil between to prevent sticking. Draw the tongue-and-groove joints tight with a pipe or bar clamp.

with T & G Flooring

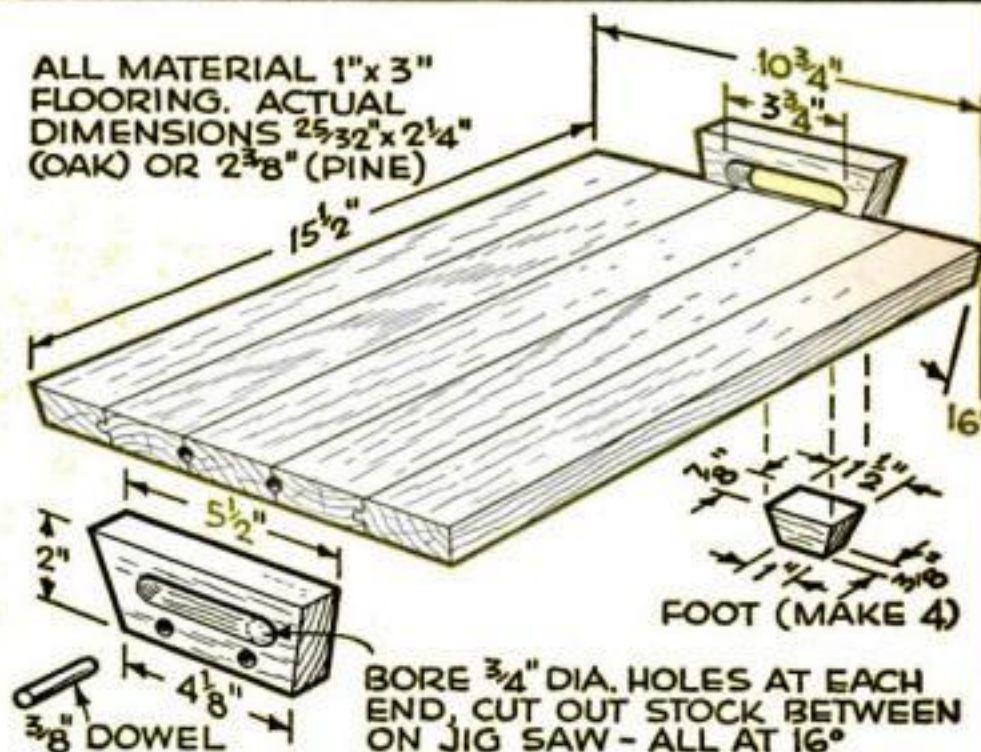
Ever think of flooring as a workshop material? It's cheap, easy to get, and simple to glue up into panels

back, which limits their usefulness in cabinetmaking. They do, however, make excellent bar tops, display shelves, and counter-top cutting boards. Even parquet flooring, with tongues and grooves on ends as well as sides, can be used.

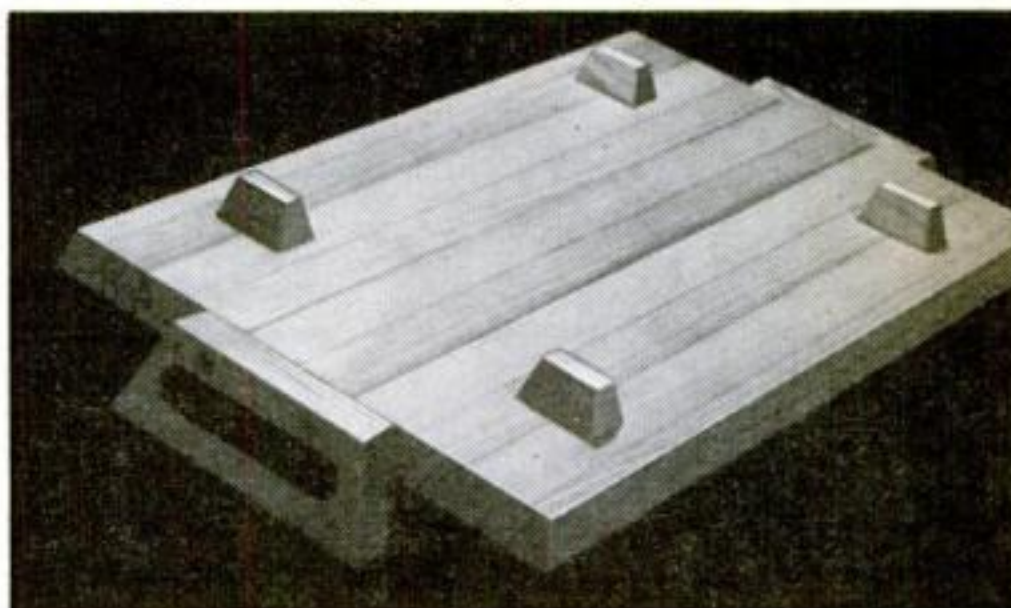
The tongue-and-groove joints in flooring don't close tight; floor boards need space for expansion. In gluing up panels for projects, therefore, you'll have to trim the grooved edge with a plane or power sander. A trial fit before final assembly ensures tight joints. It's advisable to cut adjoining pieces from a single strip of flooring because the thickness and grain pattern may vary slightly from strip to strip.

In making the Early American bench, you may want to bevel each edge to accent the planked effect. Coat both tongue and groove liberally with glue and wipe the surplus off with a damp sponge when the pieces are joined. Clamp the assembled pieces to a flat surface (such as a panel of $\frac{3}{4}$ " plywood) and use a pipe clamp to draw tongues and grooves together. But don't apply so much pressure that the glue is squeezed out of the joint. When the glue has set, remove the clamps, trim the panel to exact size, and sand. The tongue and the groove on opposite outside edges will have to be cut off, of course.

Treatment of the ends depends on the project. If tongues and grooves fit tightly, the neat, notched joints can contribute a decorative touch, as in the beveled-edge serving tray. In "pegged" pieces, like the Early American bench, it is appropriate to drill out each joint and plug it with a dowel sanded flush. The entire edge may be masked with a strip of veneer or molding—or with another member of the piece, such as a handle or leg unit.



WEDGE-SHAPED FEET underneath tray, also cut from flooring, are attached with glue. Handles are doweled to beveled ends of the tray. Note the exposed tongue-and-groove joints.



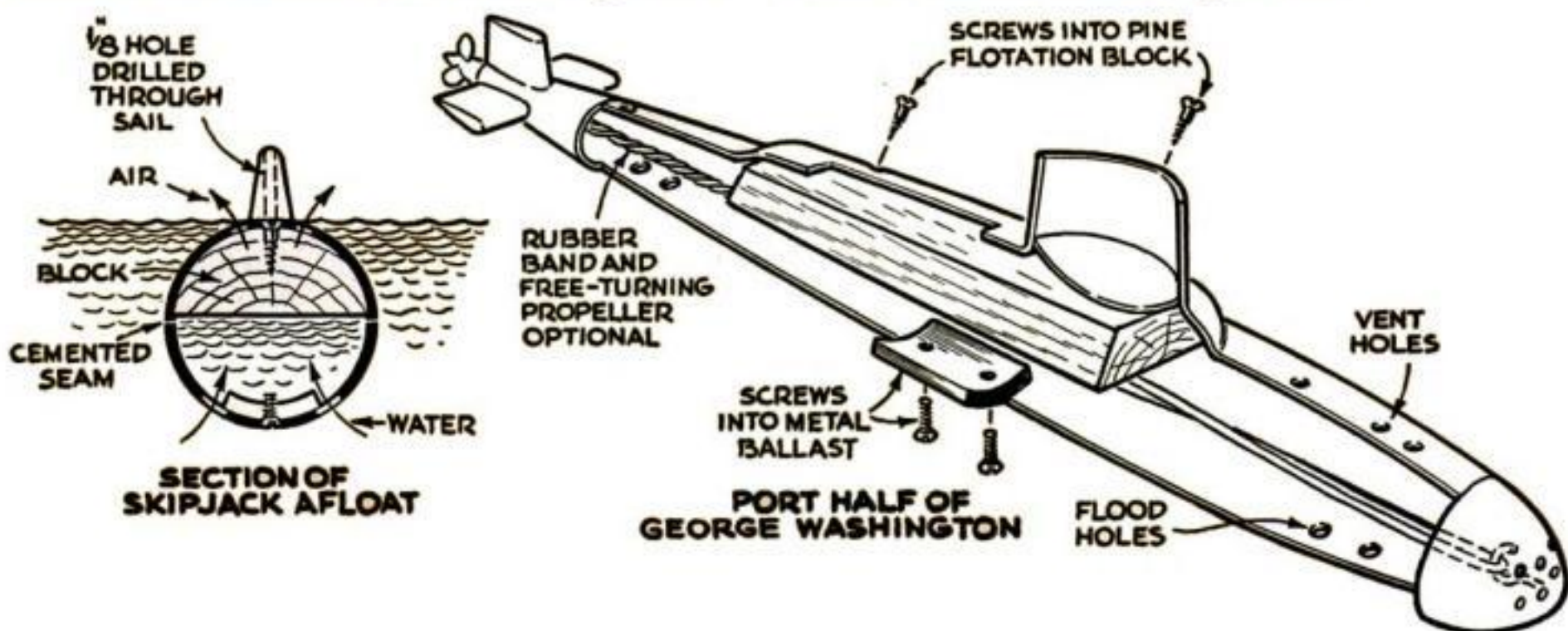
Three end-grain treatments for glued-up panels of T & G strips





SPLIT SKIPJACK (held above) has a flotation block in its top half and a ballast plate in its bottom. The assembled sub is at the right. The

larger model in the photo—and in the sketch below—has starboard panel removed to show block and ballast secured to port side.



Stripping a Kit Submarine for Action

By **L. S. McCready**

DO YOU prefer models that *work*? Plastic submarine kits are designed for mantelpiece display, but they can be brought out of drydock and put into service in your bathtub.

They'll float, dive, and resurface if you discard all the interior detail and install a fitted pine block below the conning tower. I chose two typical kits for conversion.

The George Washington. This Polaris-launching sub is the backbone of our

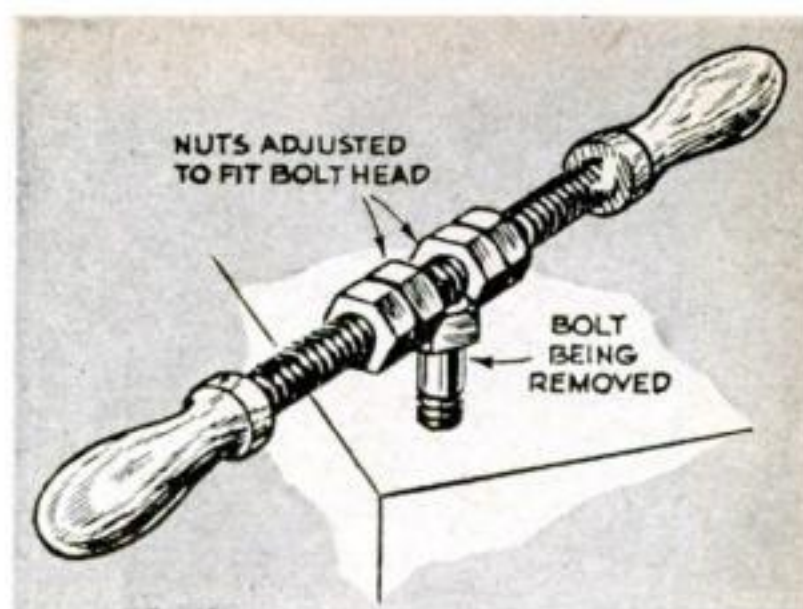
nuclear navy. The model shown is from a 1:200-scale display kit made by Renwal, Mineola, N. Y. For flotation, cut a piece of one-by-three soft pine about 9" long. Bevel the edges for a snug fit inside the humped superstructure, paint the block to make it more water-resistant, and screw it to the port half of the hull.

Using a $\frac{1}{8}$ " drill, vent the top of the hull with a pattern of holes along the seam and duplicate it on the starboard half. Switch to a $\frac{1}{4}$ " drill to make the flooding holes in the bottom—four forward and four aft. Chamfer the edges of all these holes. Drill six $\frac{1}{8}$ " holes in the nose to simulate torpedo tubes, and cement the nose and tail assemblies to the port half of the hull. Clip off all lugs projecting below the keel to hold the model in its display base.

Lay a small plate of lead or other ballast weighing at least an ounce on the floor of the hull, centered below the buoyancy block. Snap the hull halves together with rubber bands and test for flotation. The model should float on an even keel, with only the humped superstructure and tip of the rudder visible. Add to, or pare down, the ballast and shift its location until this effect is achieved. Screw it to the hull. After a final performance test, cement the two halves together. When placed in water and given a push, the model will submerge and then resurface in a realistic climb. Propulsion can be supplied by a rubber band connected to a movable propeller (the one that comes with the kit isn't intended for this purpose).

The Skipjack. This is an attack sub with the maneuverability of a dolphin. It, too, is powered by an atomic reactor. The kit—the smaller model in the photograph, and sketched in cross-section—is made by the Aurora Plastics Corp., West Hempstead, N. Y. The flotation block, here, is rounded to fill the top half of the hull. I used a pine block $\frac{3}{4}$ " thick, $1\frac{1}{2}$ " wide, and 5" long, centered about an inch forward of midships. The bottom flood holes are made with a $\frac{1}{4}$ " drill, the vents with a $\frac{1}{8}$ ". I also drilled all the way down through the sail after it was cemented to the hull. This piece covers the two screws used to attach the block.

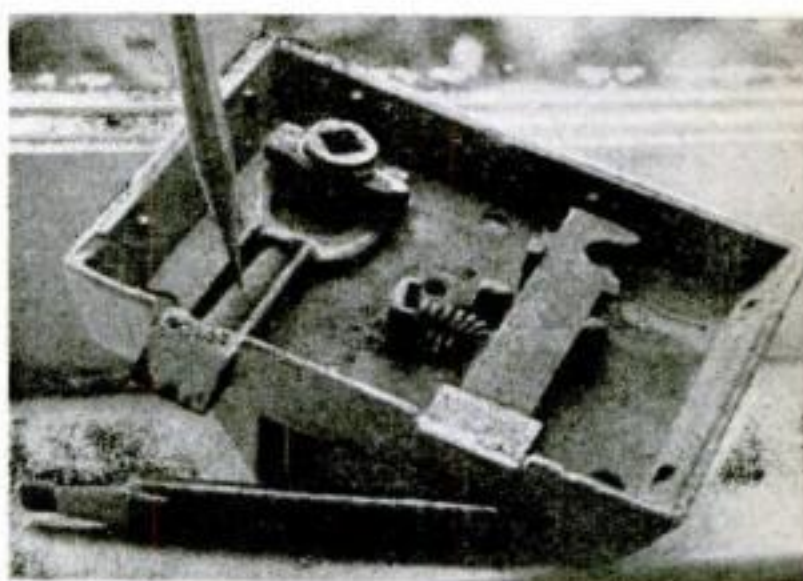
You won't, of course, be able to use the decals supplied with the kit. Any decorations will have to be painted on.



Wrench from Threaded Rod

IN AN emergency, this improvised wrench will work almost as well as a real one. Near the center of a length of threaded rod, space two nuts to fit the head of the bolt you must turn. Lock the nuts in position with jam nuts tightened against them. Slip file handles on the ends of the rod to give you a better grip and allow you to swing the tool with both hands.—*Federico Strasser, Santiago, Chile.*

▶▶▶ON A recent auto trip the exhaust-manifold nuts loosened and the gasket blew. Tightening the nuts wouldn't silence the noise. Then I hit on the idea of shaping an emergency gasket from the fiber-glass insulation under the hood. Holes for exhaust ports and studs were easy to form, and the gasket held up for the rest of the trip.—*John Kovacs, Depew, N. Y.*



Eraser Replaces a Spring

OCCASIONALLY, in older houses, a door latch will fail to work because of a broken latch spring. A long-lasting repair can be made by installing a suitable length of pencil eraser in the mechanism in place of the spring.—*R. A. Davison, Milton, Ont.*

HOW TO MAKE A Copper Weather Vane in 3-D

By Loomis C. Miller

USING inexpensive modern materials, you can make a three-dimensional weather vane that will rival those made in early New England by hammering copper sheets into cast-iron molds.

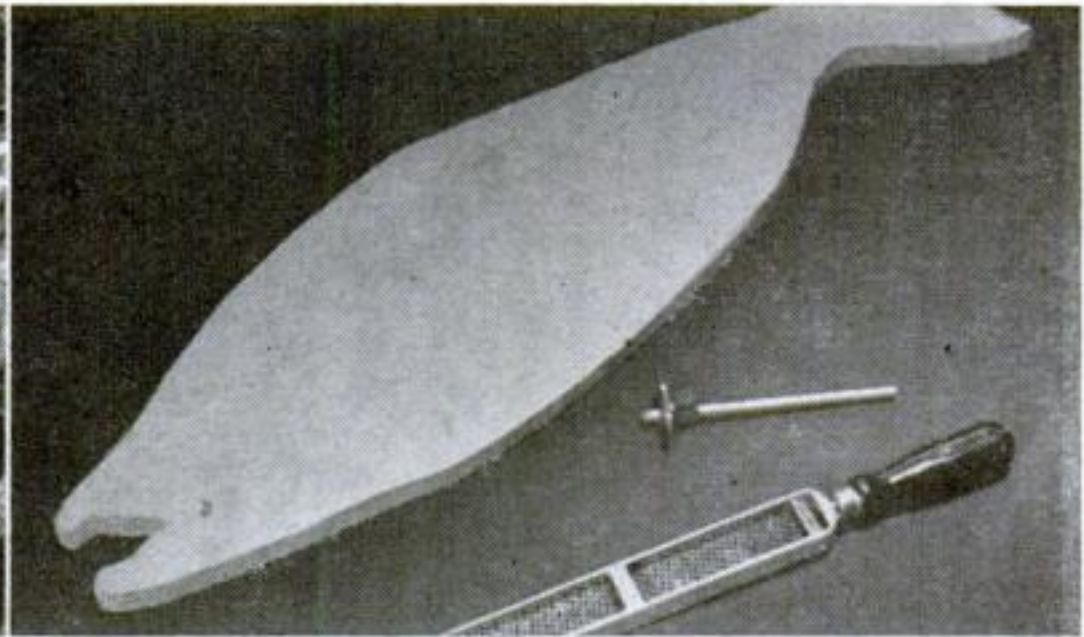
This weather vane, a reproduction of the Puget Sound king, or "tyee," salmon, was made by covering a wood form

with hobby-shop copper foil, then embossing the metal with a wood stick. Kept bright by a coating of clear lacquer, or allowed to weather to a copper-oxide green, the fish will last for many years.

The same technique can be used to shape only one side of a figure to make a striking wall decoration. The lines can be highlighted with dark paint.



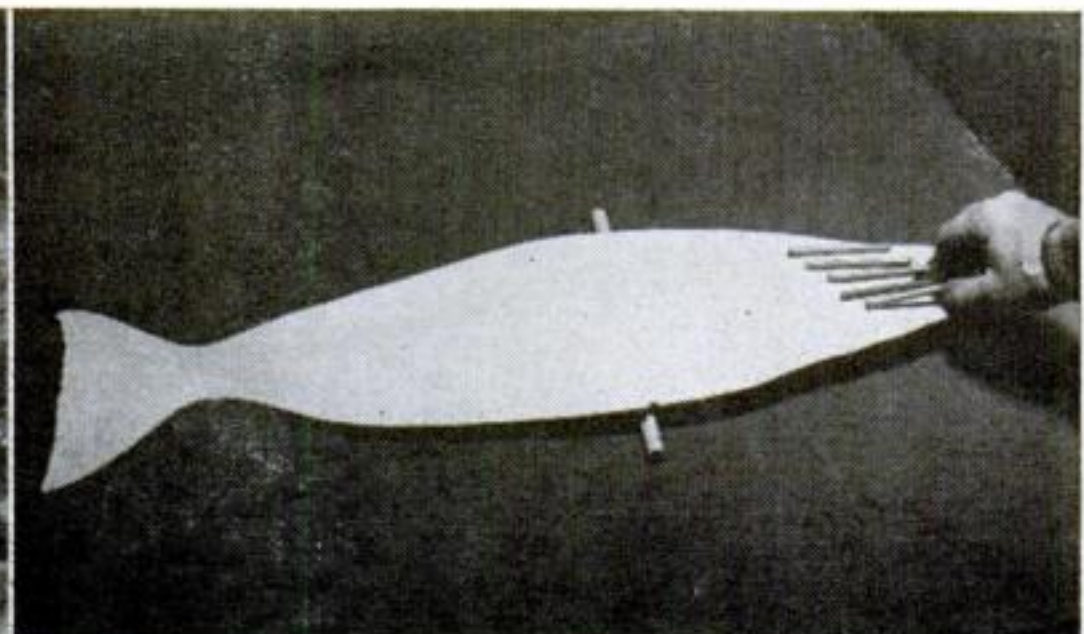
1 ANY FISH CAN BE YOUR MODEL. Have a photo of your prize catch or favorite fish enlarged by photocopying, or scale it up to the desired size by drawing it on ruled squares.



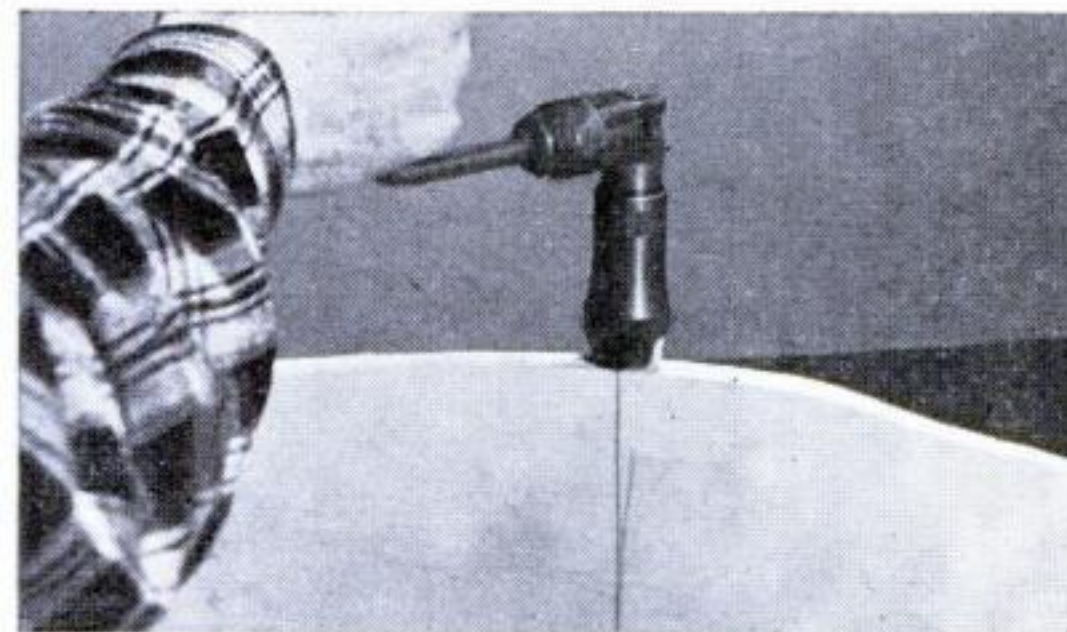
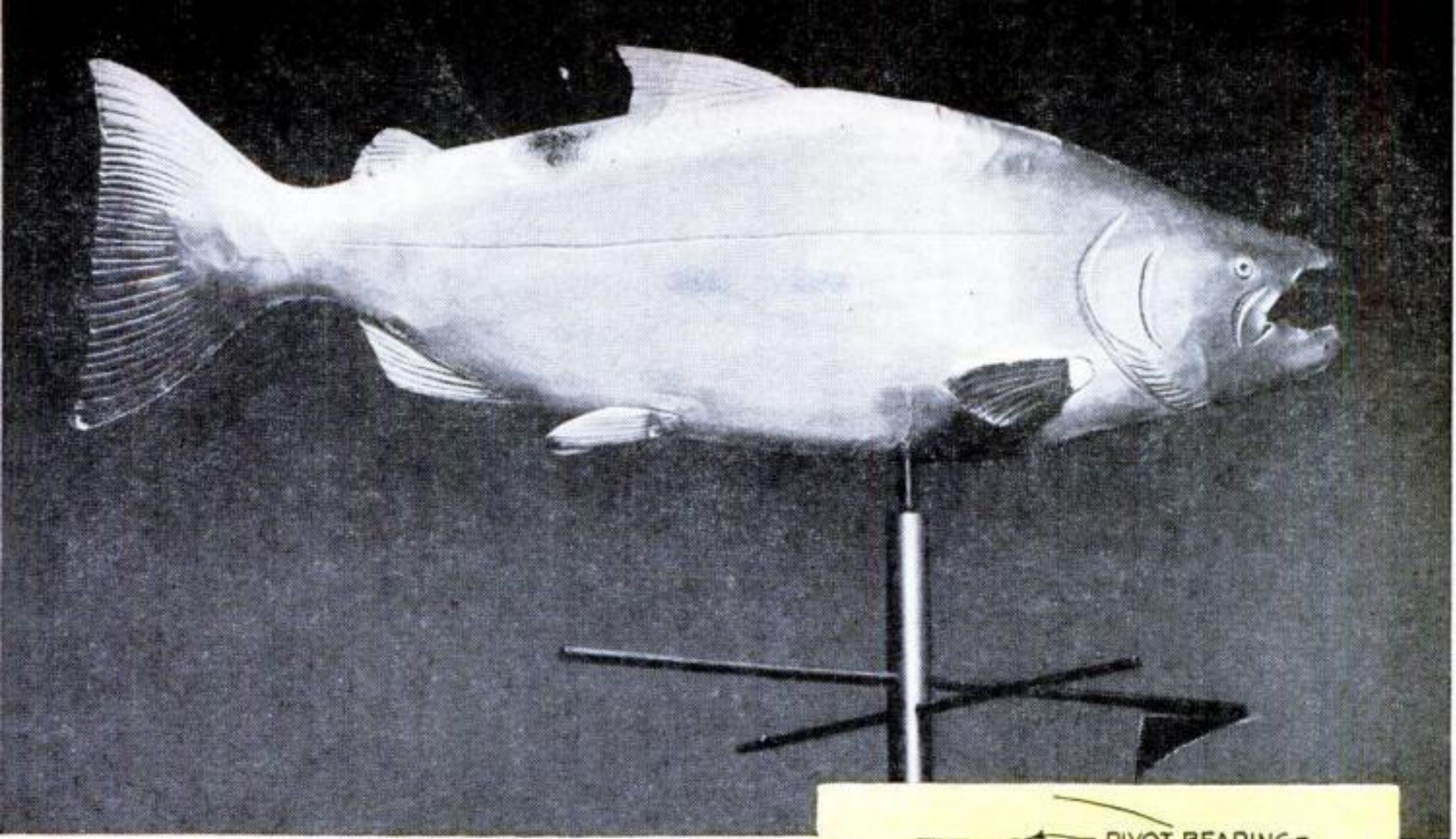
2 AFTER TRACING THE OUTLINE on a clear board of pine or cedar, cut it out with a jig- or coping-saw. The salmon shown is 32" long, and was cut from one-by-ten clear pine.



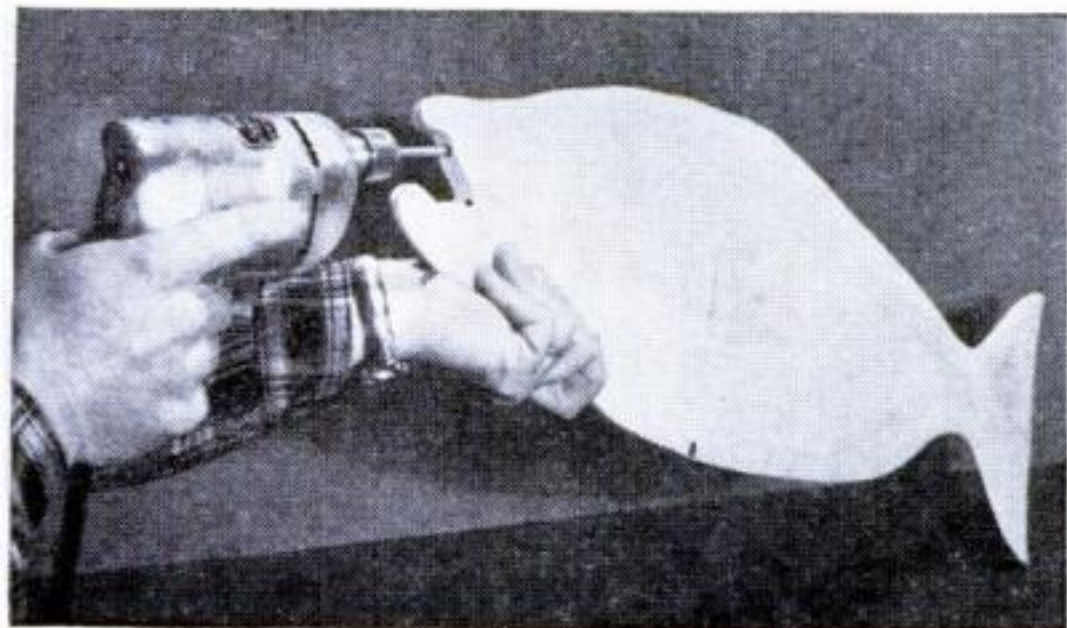
4 TAPER THE BODY by planing until it is $\frac{1}{2}$ " thick at the head and $\frac{1}{8}$ " at the tail. Shape the oval cross section to the centerline with a rasp, and sand smooth and free of any bumps.



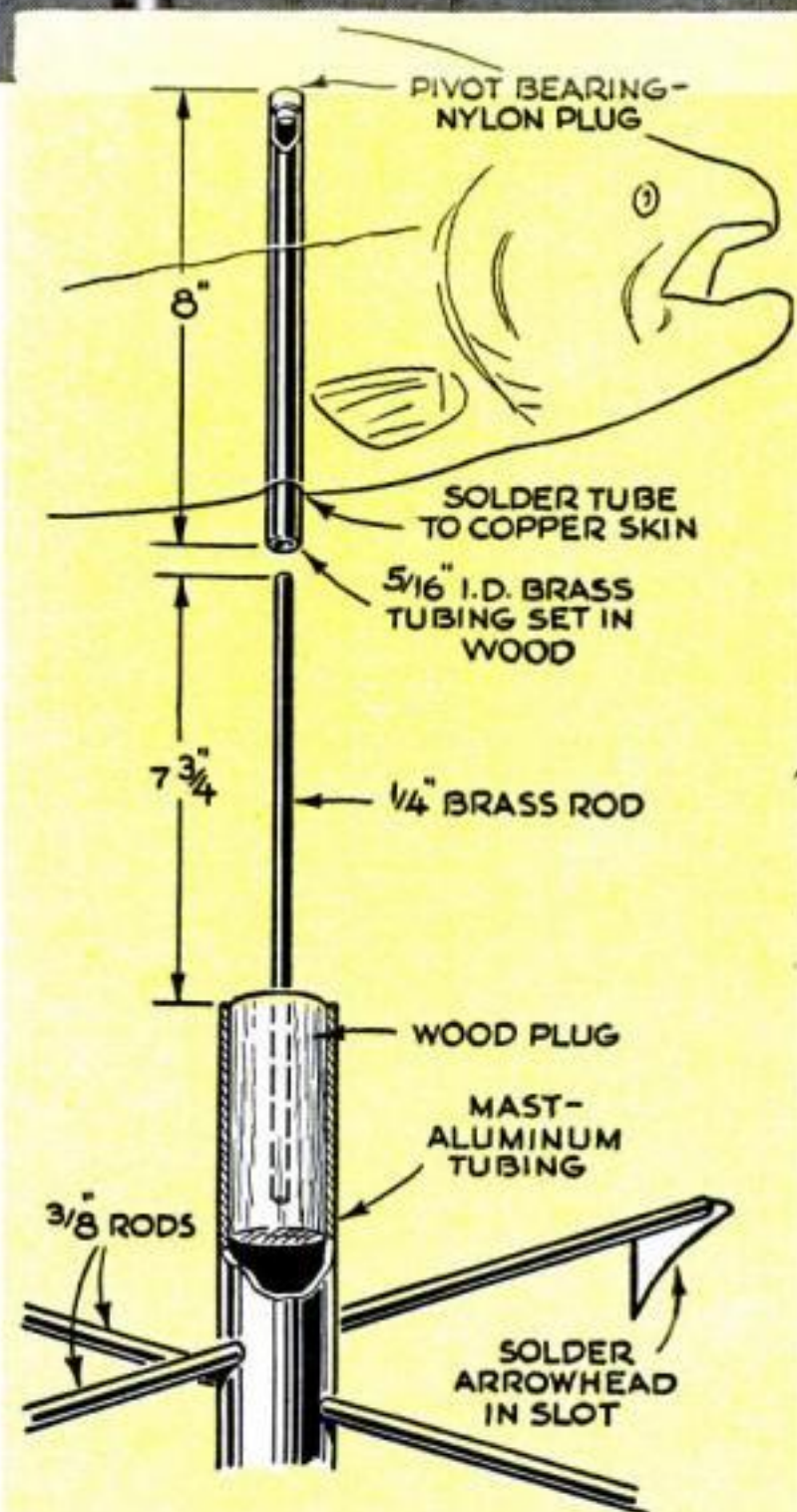
5 THE BODY MUST BE BALANCED, since the pivot is off center to make the fish swing into the wind. Place weights on the head until the fish teeters on a dowel under the pivot point.



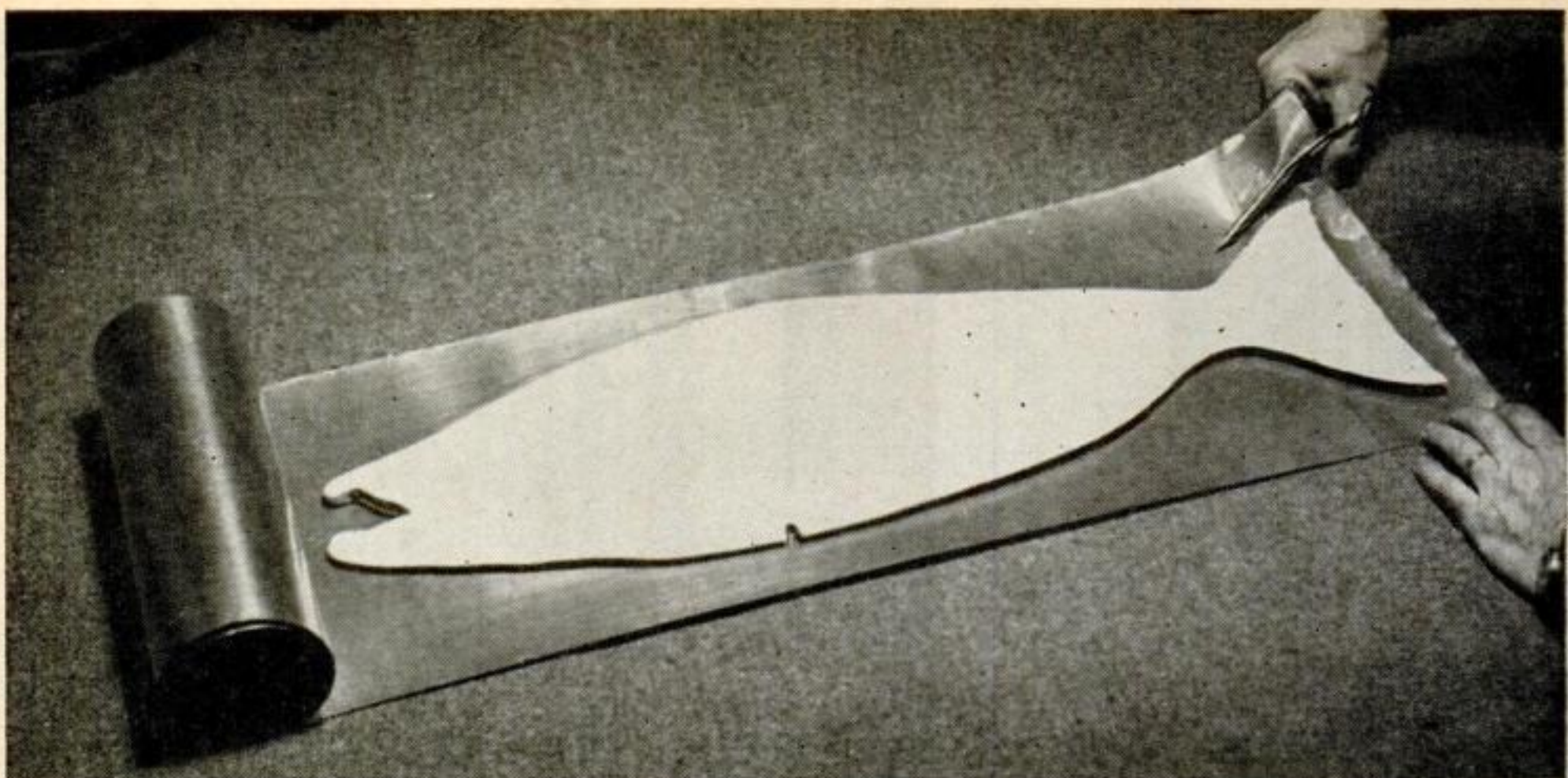
3 BORE A HOLE about one-third back from the nose and two-thirds into the width of the fish for the pivot tube. Scribe a centerline around the edge of the wood to guide shaping.



6 EMBED THE WEIGHTS in holes drilled in the head. Lead rod, used to make fishing sinkers, is handy for the weights. It cuts easily and will fit into $\frac{1}{4}$ " holes. Recheck the vane's balance.



MAKE A FREE-SWINGING PIVOT from brass tubing that fits easily over $\frac{1}{4}$ " drill rod. Drive a nylon plug in one end of the tube and press it into the fish. Fit the rod into a wood plug in the mast.

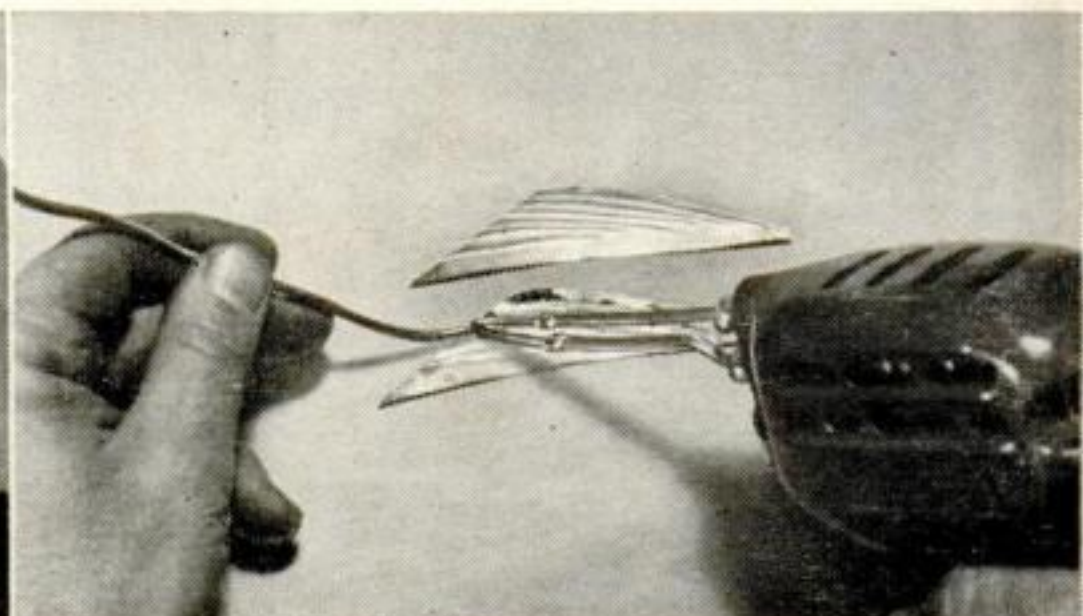
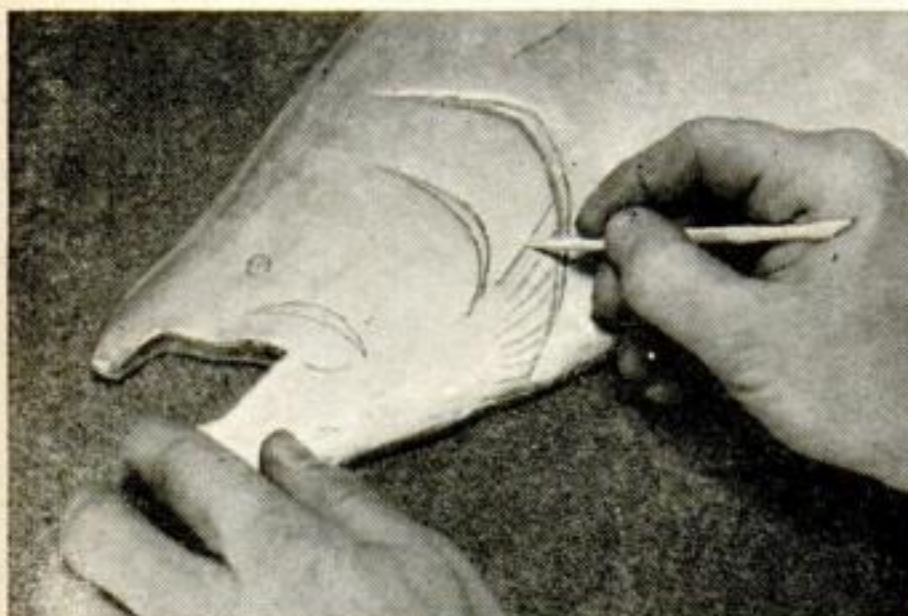
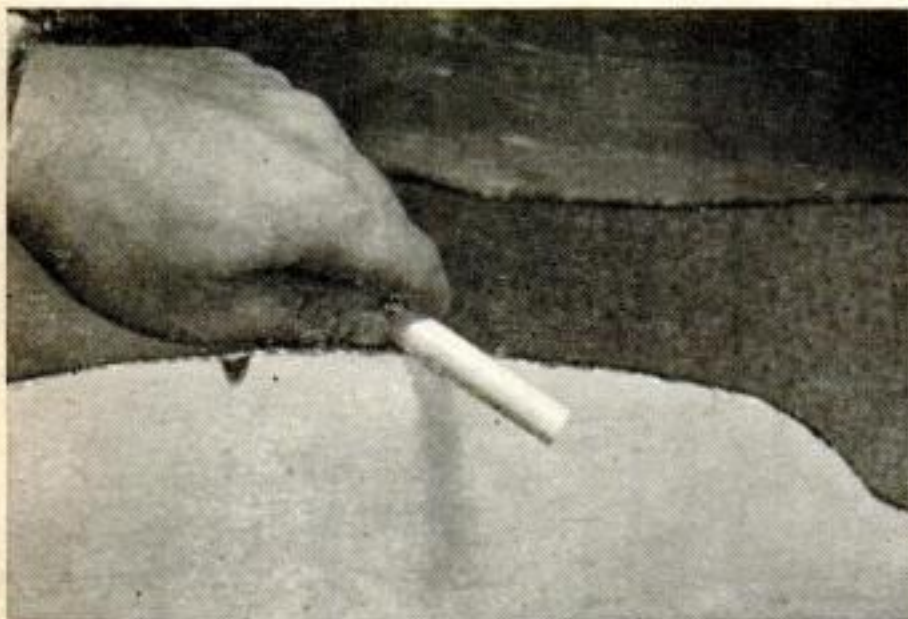


7 **EMBOSSING FOIL**, sold in hobby shops, is used to cover the fish. Working on a blanket

to avoid damaging the foil, cut the two sides about $\frac{1}{2}$ " larger than the wood form.

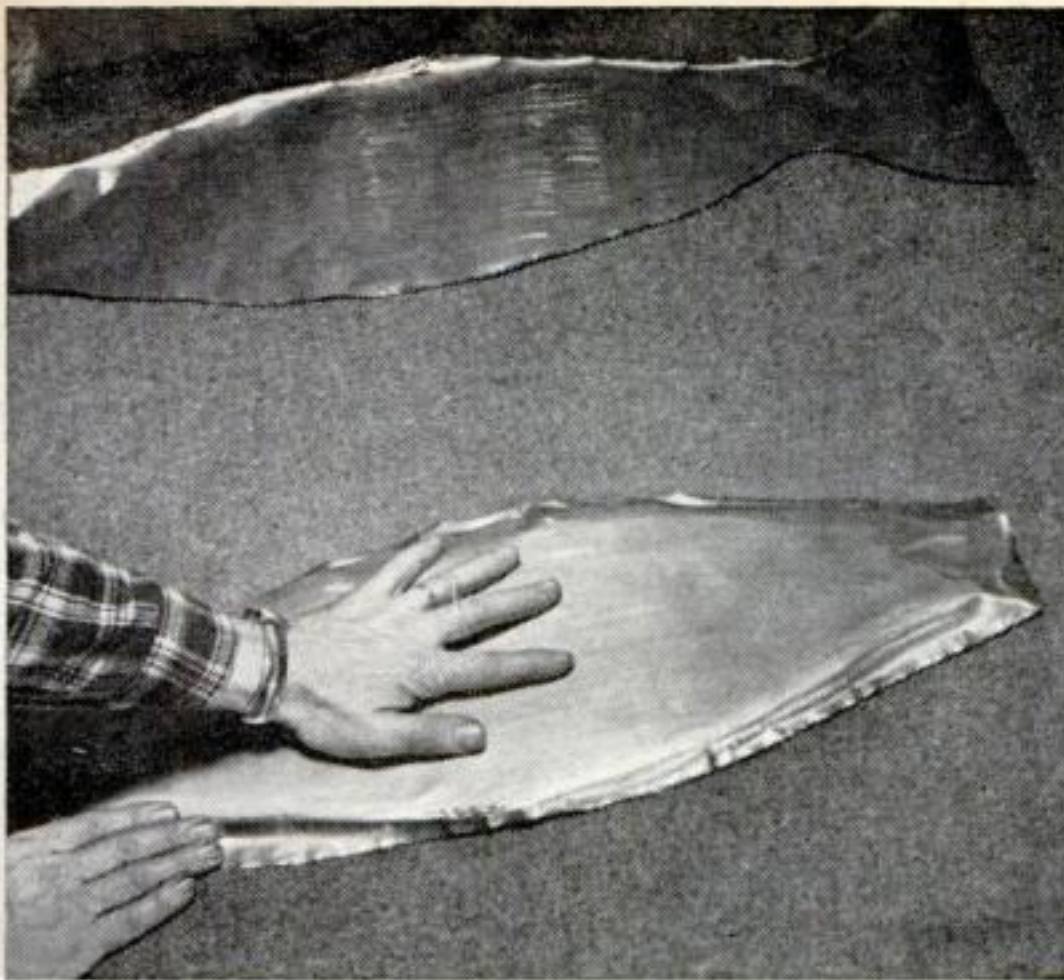
10 **PLACE THE FOIL ON THE FORM** and rub it with a dowel to roll it snug over the edge. Again, trim with scissors to a close fit. Cover the other side and trim the same way.

11 **APPLY SOLDER WITH AN IRON**, then use a torch set to a low flame to flow solder into the seam. Plain wire solder and separate flux will work better than flux-core solder.

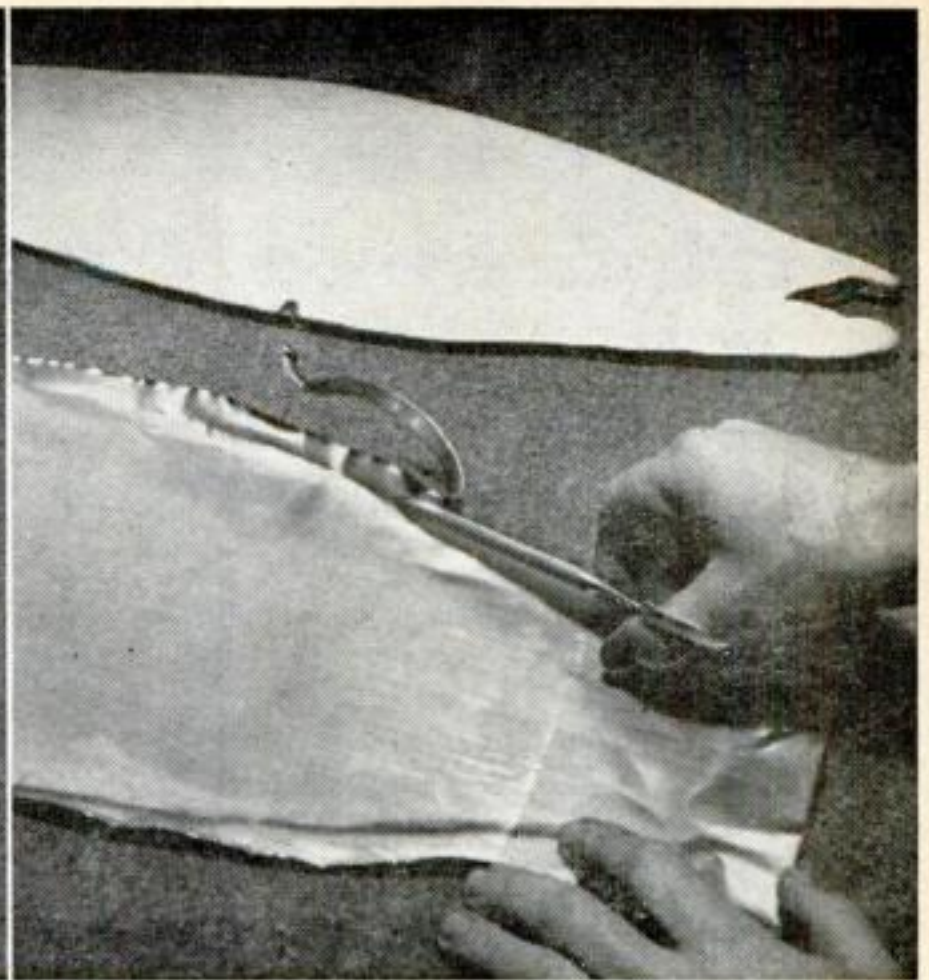


13 **GO OVER THE LINES** with a manicure stick to emboss them into the metal. Start lightly, then deepen the lines with successive passes. Use wide end of stick for large areas.

14 **MAKE EACH FIN** by soldering together two thicknesses of foil. Spread one edge to a V and solder to the body. Burnish the fish with fine steel wool and coat with clear lacquer.



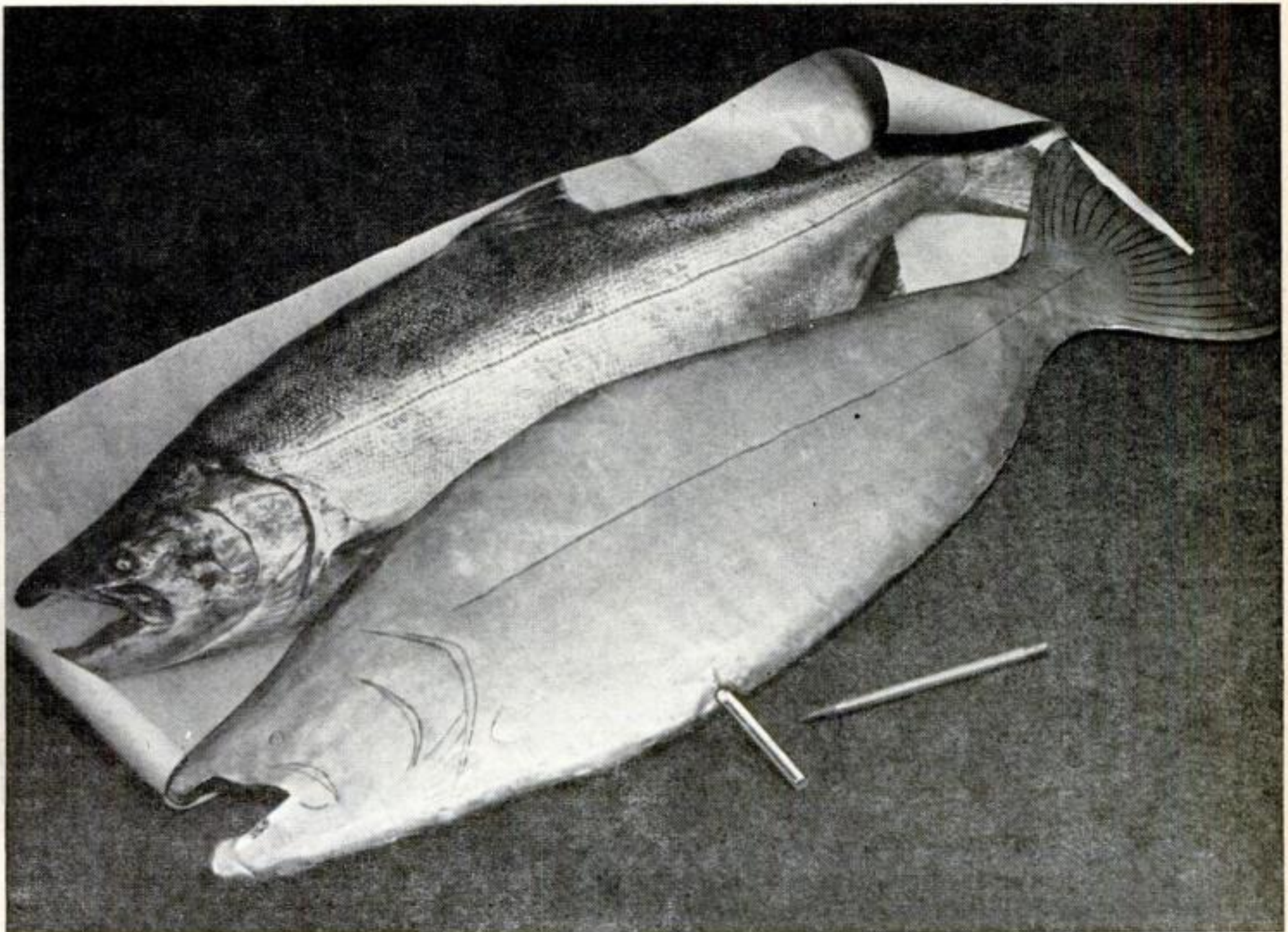
8 PRESS THE FOIL over the wood form with the palms of your hands until a sharply defined outline of the fish is indented in the metal. Don't roll the edge over yet.



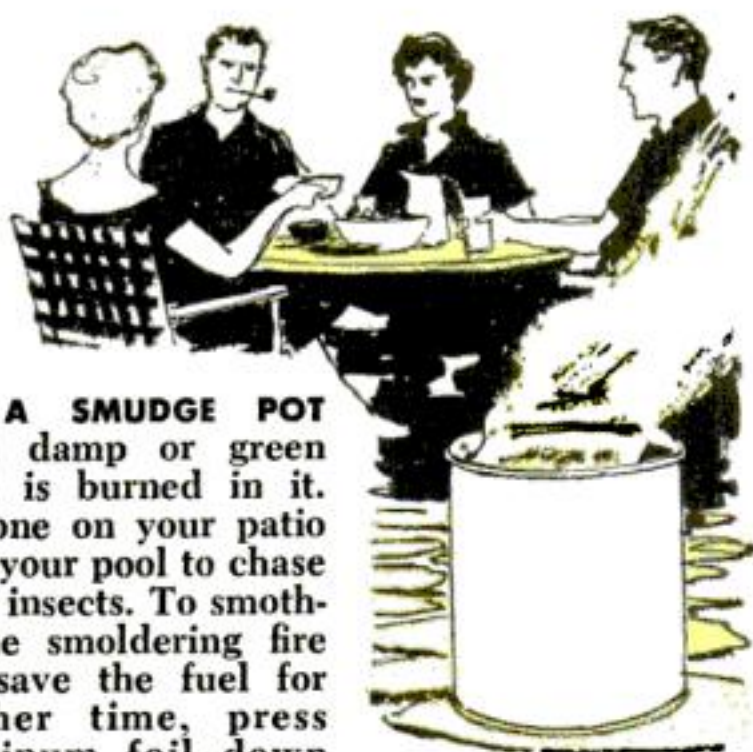
9 TRIM THE FOIL to $\frac{1}{8}$ " of the indentation to remove excess metal that would cause wrinkles if rolled around the form. Handle the foil carefully to avoid dents and wrinkles.

12 ADD PROMINENT DETAILS by laying the photocopy and carbon paper over the fish

and tracing them on the metal skin. Don't press too hard—a mistake will leave an impression.



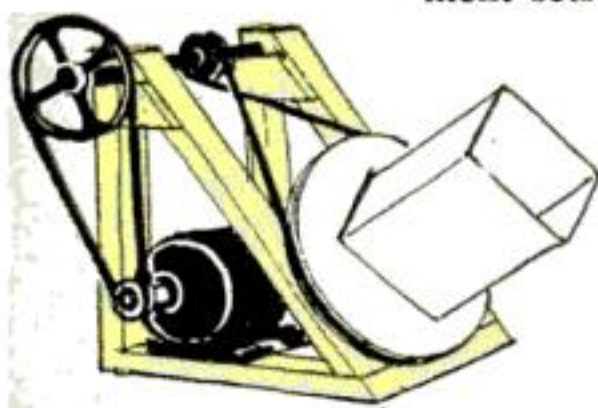
Nine Lives of a One-Gallon Antifreeze Can



IT'S A SMUDGE POT when damp or green wood is burned in it. Use one on your patio or at your pool to chase away insects. To smother the smoldering fire and save the fuel for another time, press aluminum foil down over the top.



IT'S A HITCH, counterbalance-weight, or small-boat anchor when you fill it with cement and insert an eyebolt before the cement sets completely.



IT'S A TUMBLING BARREL for finishing small items when you revolve it slowly on this setup. Mount it on a wood disk with a grooved edge and connect it to a motor with the pulley system shown.



IT'S A LARGE SCOOP for grain, sand, or sawdust when you cut it diagonally and bolt on a wooden handle with a washer.



IT'S A CAMP SHOWER easily improvised by perforating the bottom. Hang it from a tree and use a second can for pouring.

IT'S A TV STOOL for a tot (or an adult's footrest) when you weight it with sand. Insert a 1"-thick wood disk padded with foam rubber and covered with upholstery cloth folded under and tacked.

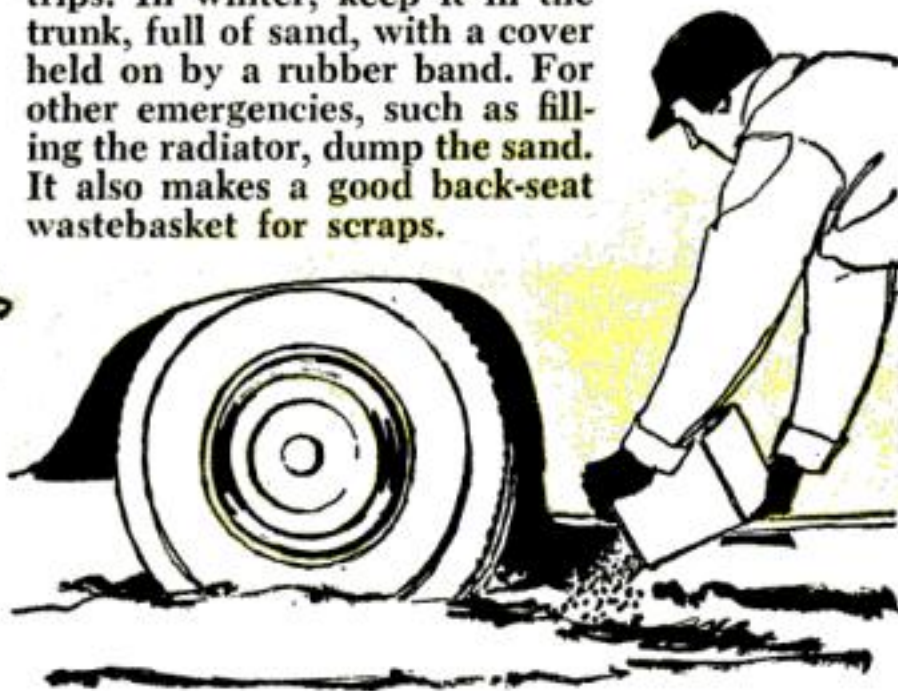


IT'S A FUNNEL for antifreeze, motor oil, or photo chemicals when you solder copper tubing into a hole at the bottom.

IT'S A UTILITY BUCKET for car trips. In winter, keep it in the trunk, full of sand, with a cover held on by a rubber band. For other emergencies, such as filling the radiator, dump the sand. It also makes a good back-seat wastebasket for scraps.

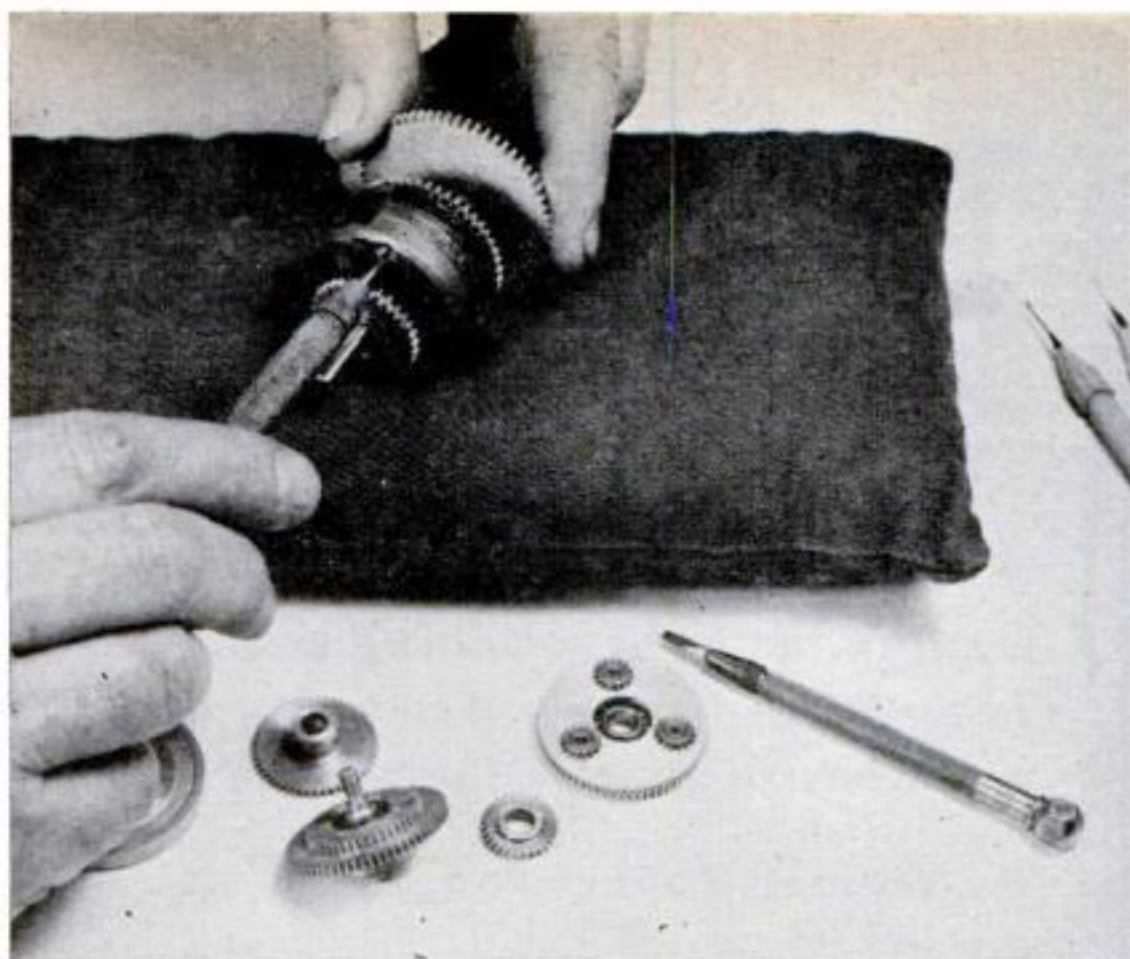


IT'S A DRAG ANCHOR for an aluminum boat when towed behind, open-end first. It lets you fish a selected spot by preventing excessive drift caused by wind against a lightweight hull.



Short Cuts and Tips

FROM PS READERS



Pillow Nests Small Parts

A CANVAS bag filled with fine lead shot makes a good work support for instrument assembly and delicate repairs. The

bag adapts itself to the contours of irregular pieces, providing both a nonslip work surface and protection against finish mars.—*H. J. Gerber, Stillwater, Okla.*



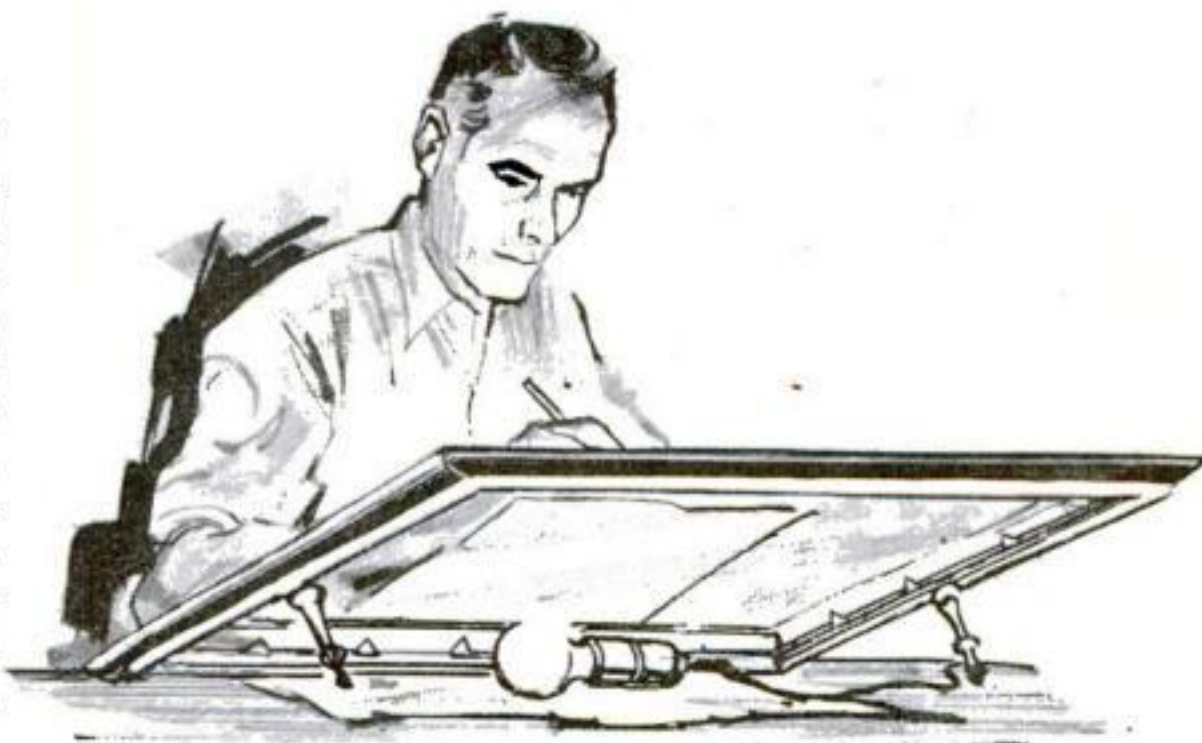
Shaving Brush Glue Spreader

A WORN-OUT shaving brush with its bristles trimmed about an inch long makes a handy glue spreader.—*Anthony Capotosto, Jersey City, N. J.*

▶▶▶SENDING a cake to camp? Remember that soldiers or children at school aren't likely to have a large knife handy for slicing. Enclose a generous piece of clean #8 or #10 sewing thread—or crochet cotton—so they can divide the cake with their buddies.—*Lilah Schultz, Chicago.*

Picture-Frame Tracing Table

NEED to trace a pattern in a hurry? You can improvise a tracing table from a sturdy wooden picture frame by screwing a metal door-bumper into the back of both short lengths of molding. The backing, picture and matt are removed, leaving only the glass in place. Light source is a 10- to 25-watt bulb placed underneath. An asbestos pad protects the desk.—*F. C. Gardner, San Angelo, Tex.*





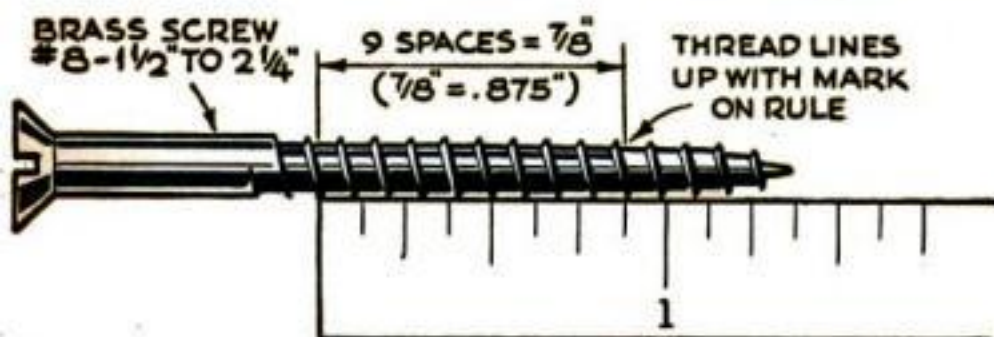
They make real working models:

Worm Gears from Wood Screws

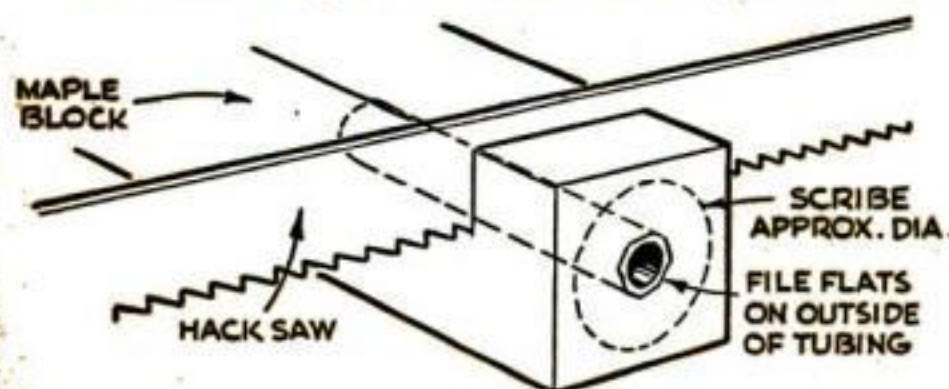
A screw shank is the worm. Heated, its threads burn matching gear teeth in a disk of hardwood to give you a miniature gear-reduction unit

By Wilmer Robert Taggart

How to make the worm and gear in any ratio you want



TAKE ANY SIZE SCREW—to make the worm. To find the gear diameter, use the formula above right. Count the spaces between threads that fall within any even measurement ($\frac{7}{8}$ " here).



CUT THE GEAR BLANK from maple or other fine-grain hardwood. File flats on a short length of $\frac{1}{8}$ " i.d. thick-wall brass tubing and press the piece into an undersize hole drilled in the wooden blank to make a bearing. Use rod if a shaft is required on the gear.



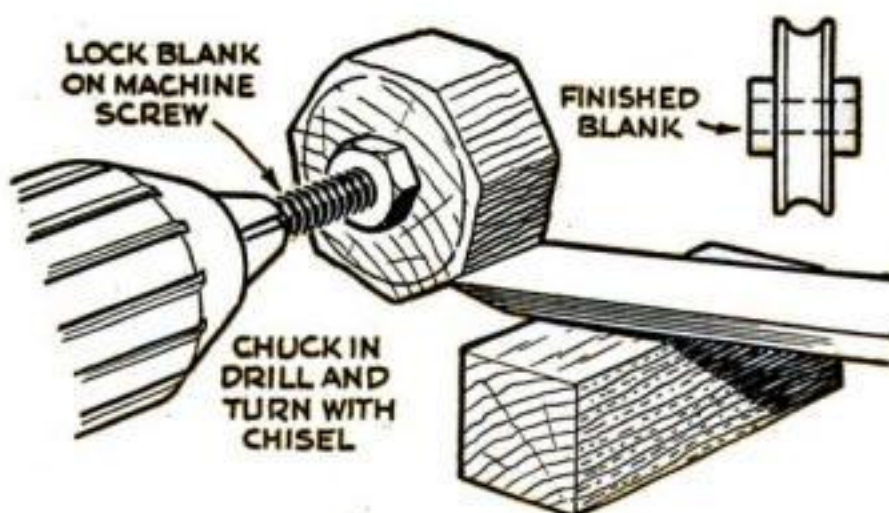
HEAT THE SCREW with a torch and roll the gear blank against it firmly to burn the threads into the wood. Continue heating the screw and burning in threads until the entire gear is formed. If you find that the teeth do not come out even at the end, chuck the gear in the drill and reduce its diameter slightly.

$$\text{PITCH} = \frac{.875"}{9} = .0973"$$

$$\text{DESIRED RATIO: } 33 \text{ TO } 1$$

$$\text{GEAR DIA.} = \frac{33 \times .0973"}{3.1416} = 1.022"$$

Dividing this measurement by the spaces (9 here) gives you the screw's pitch. Multiply the pitch by the desired ratio and divide by pi (3.1416) to get the required gear diameter.

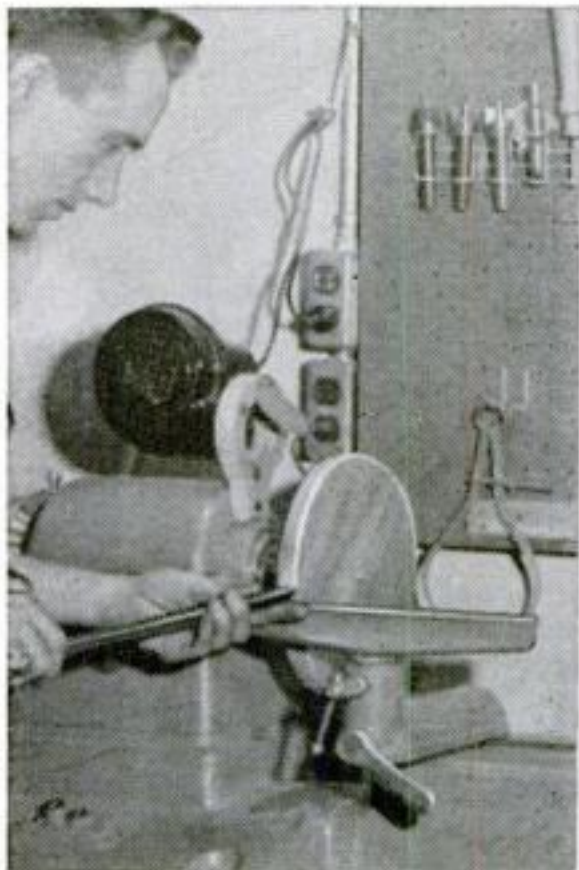


MOUNT THE GEAR BLANK on a machine screw and chuck it in an electric drill held in a vise or bench stand. Using a block of wood high enough to support a chisel, turn the blank to the calculated diameter and sand it smooth.



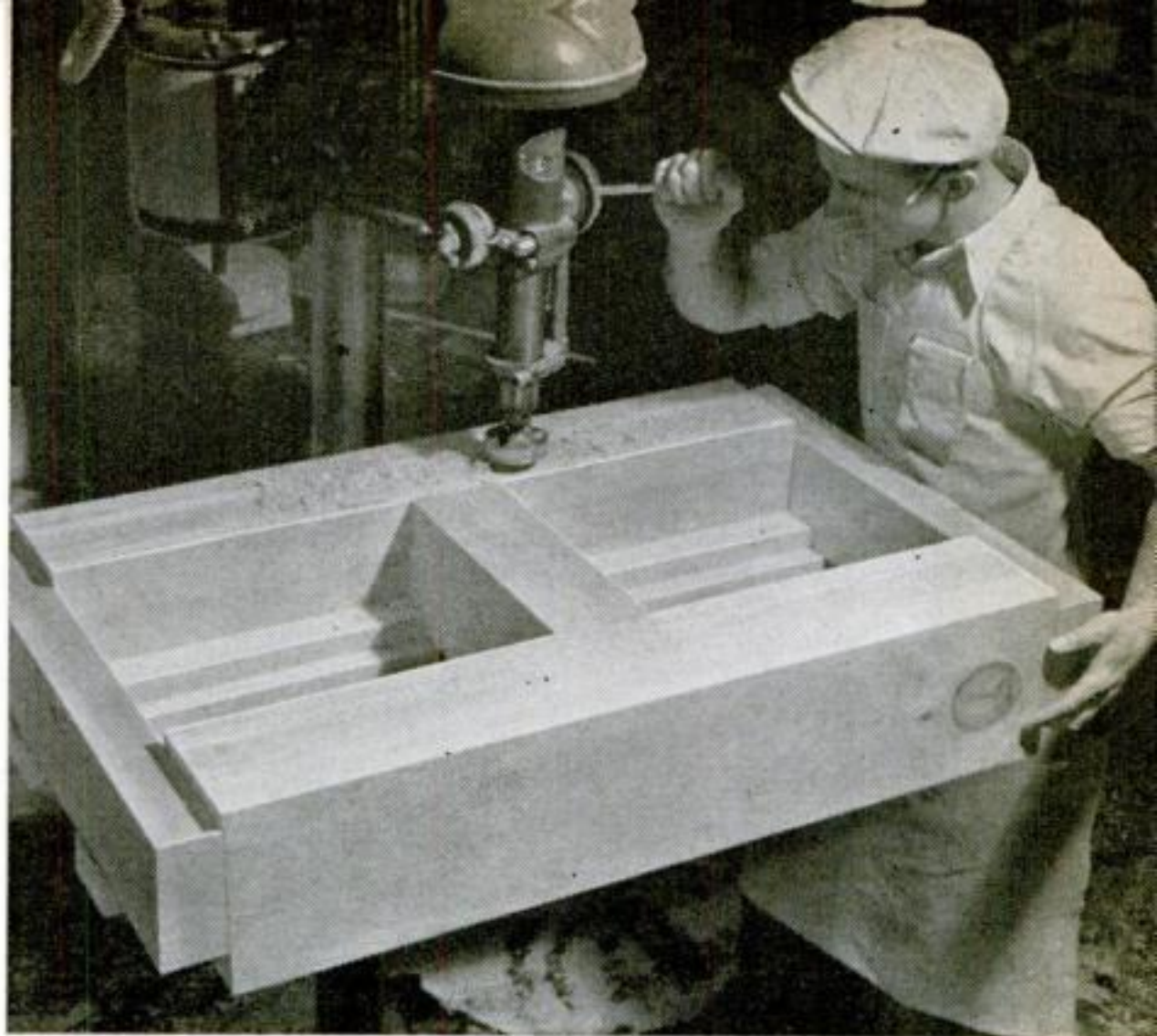
MAKE THE WORM from a screw identical with the one used for burning in the threads. Chuck it in the drill and turn a short $\frac{1}{32}$ "-diameter shaft on one end for a bearing, and a long one on the other. Thin plastic tubing pressed over the long end makes a good flexible coupling between the worm and a small motor.

SURFACE PLANING on a drill press is a neat idea for large pieces like pattern assembly at right. A plywood auxiliary table bolted over the regular one makes it easy to handle awkward pieces. You can buy a planer head at hardware stores.



A BLOWER is mounted on the headstock of this lathe to blow wood chips away from the operator as they come off the chisel. This keeps his work area uncluttered and permits steady operation without interruptions for sweeping up.

RECESSES ARE SHAPED automatically on this foolproof jig clamped to the shaper table. Disks to be recessed are simply pressed onto the spinning cutter and moved about within the circular confines of the jig until they are fully cut.



Many home-shop power tools are used in big industrial plants. Here are some examples of—

Factory Tool Setups You Can Use at Home

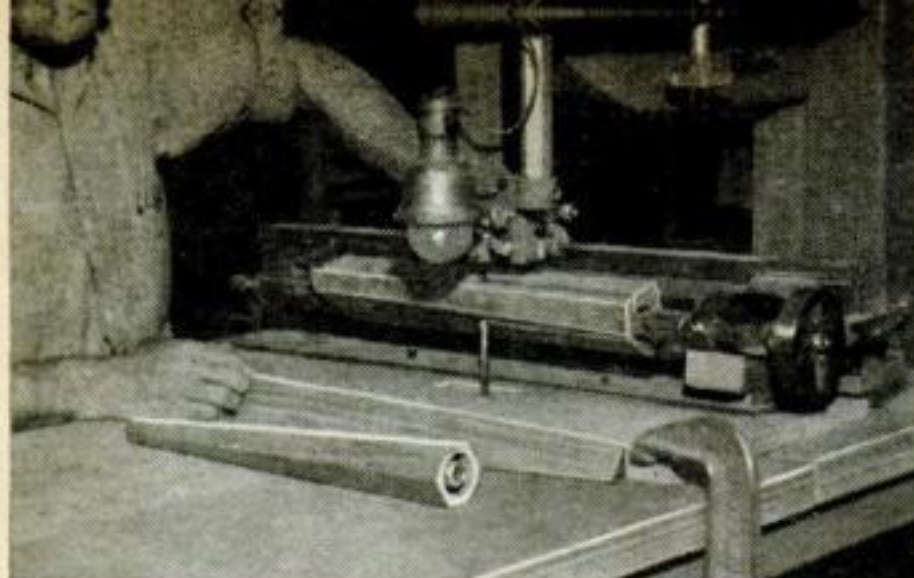
By Herbert R. Pfister

YOU can usually learn something by looking over the other fellow's shoulder while he works. You can do just that by studying these photos showing how men in industry handle special operations or short production runs economically. In each case they've rigged small machines—home-shop size—to take the load off industrial tools.

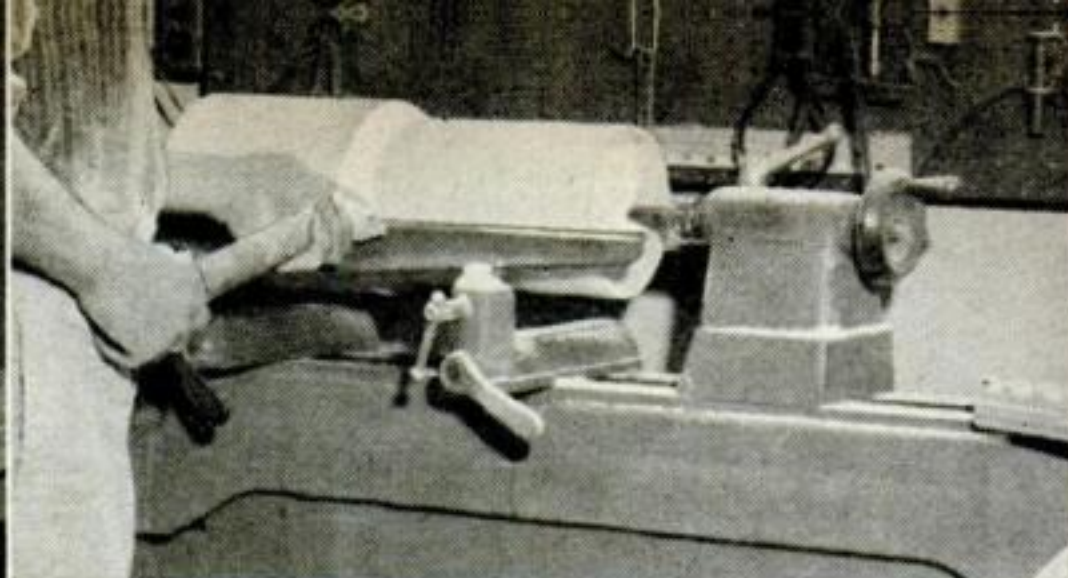
The setups illustrated can be used to simplify or speed home jobs and improve accuracy. They may even stimulate ideas for ingenious arrangements of your own. The photos were made by Delta.

CONTINUED

179



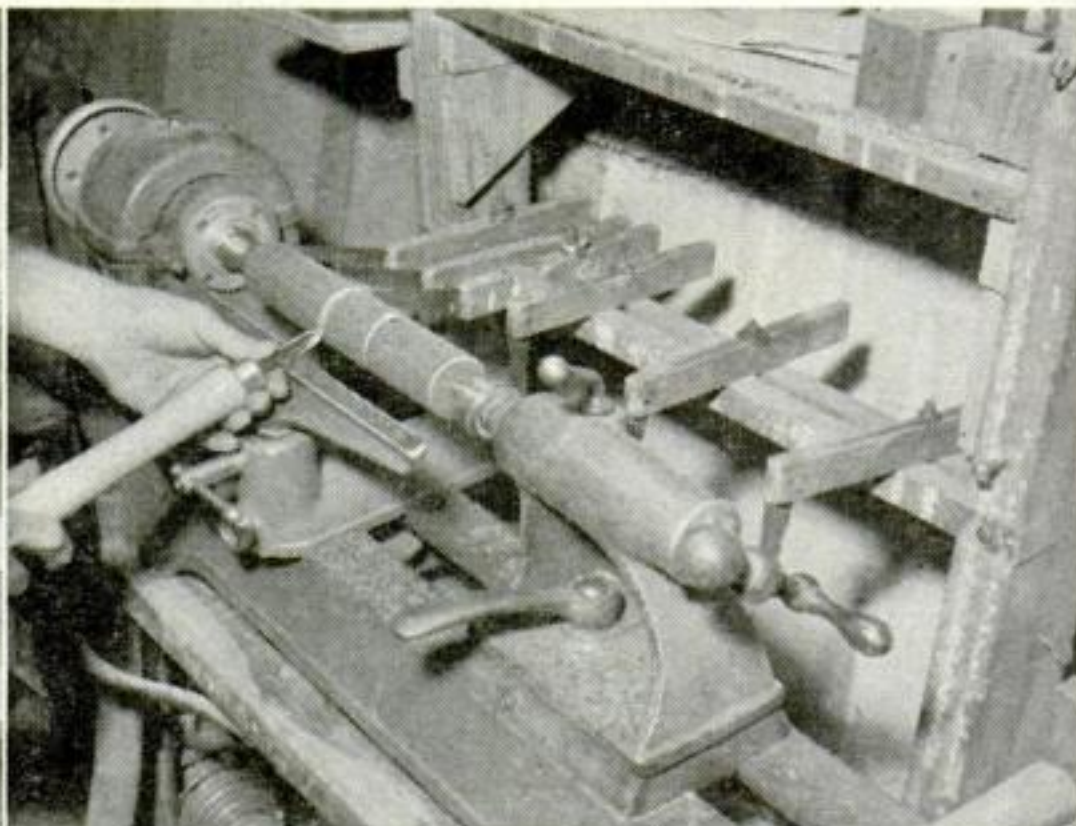
AN OLD MODELMAKING LATHE holds stock between its centers while it is passed through the bandsaw diagonally to cut tapered hexagonal furniture legs. The lathe's indexing head is used to position the leg for the six cuts.



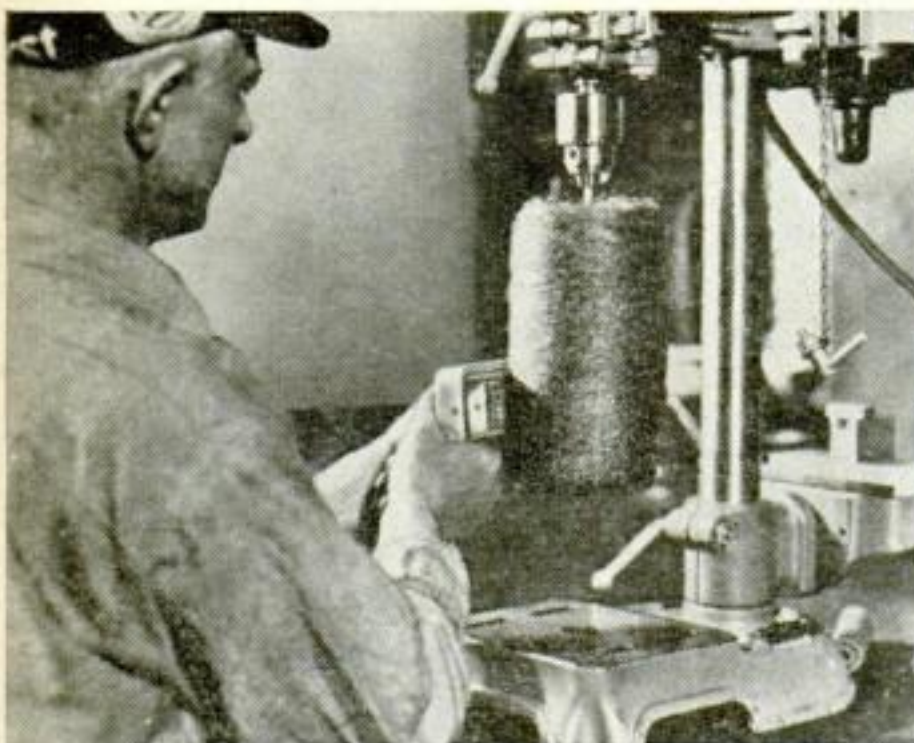
TO MAKE CHUCKING EASY, a lamp designer casts plaster blanks for lamp-base patterns around pipe running through their centers. When hard, the bulky bases are set up for lathe turning by chucking the protruding ends of the pipe.



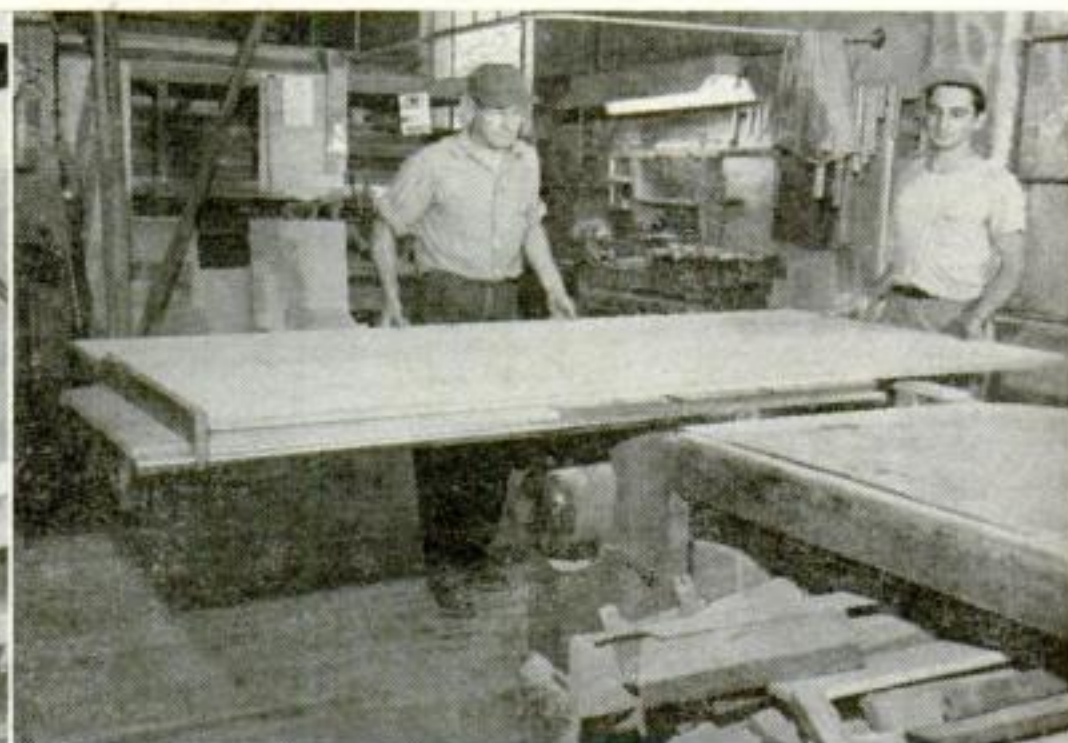
TRIANGULAR LAMP BASE of wood is formed on the table saw. After the stock is glued to form a flat-sided triangle, it is passed lengthwise over a dado cutter to rough-shape it. Final cut is made across the blade as shown.



SHEET-METAL FINGERS drop automatically when stock is turned to required diameter. Fingers are preset against a template or master turning. Finger supports are locked in position on a slotted strip at the rear of the lathe.



SIMPLE, BUT EFFECTIVE: Steel wool wrapped around a mandrel in the drill-press chuck is used to deburr and polish metal parts. Most pads of steel wool can be unrolled into a strip that's easily installed on the mandrel.

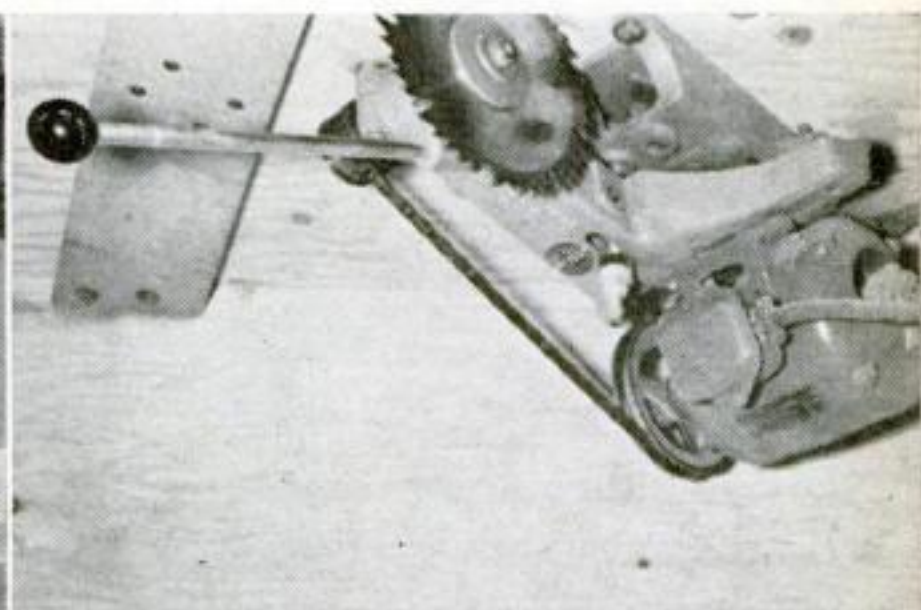
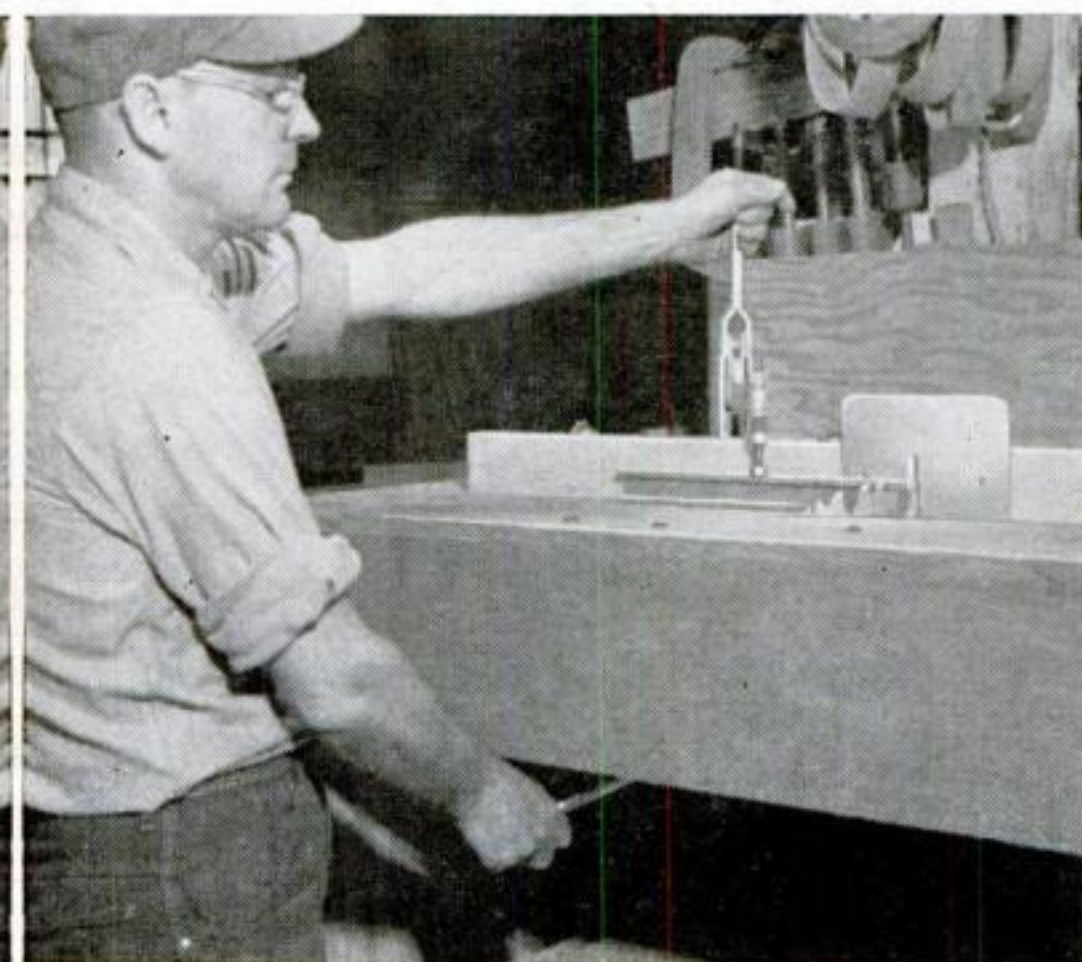


A SAW-TABLE EXTENSION and lengthened guide bars for the fence widen this saw's capacity for cutting large panels. Although not used here, a pair of legs at the end of the extension would add rigidity to a home-built job.



BELT SANDING large-diameter table tops goes faster because a support holds the work against the sander. The table top is pinned to the sup-

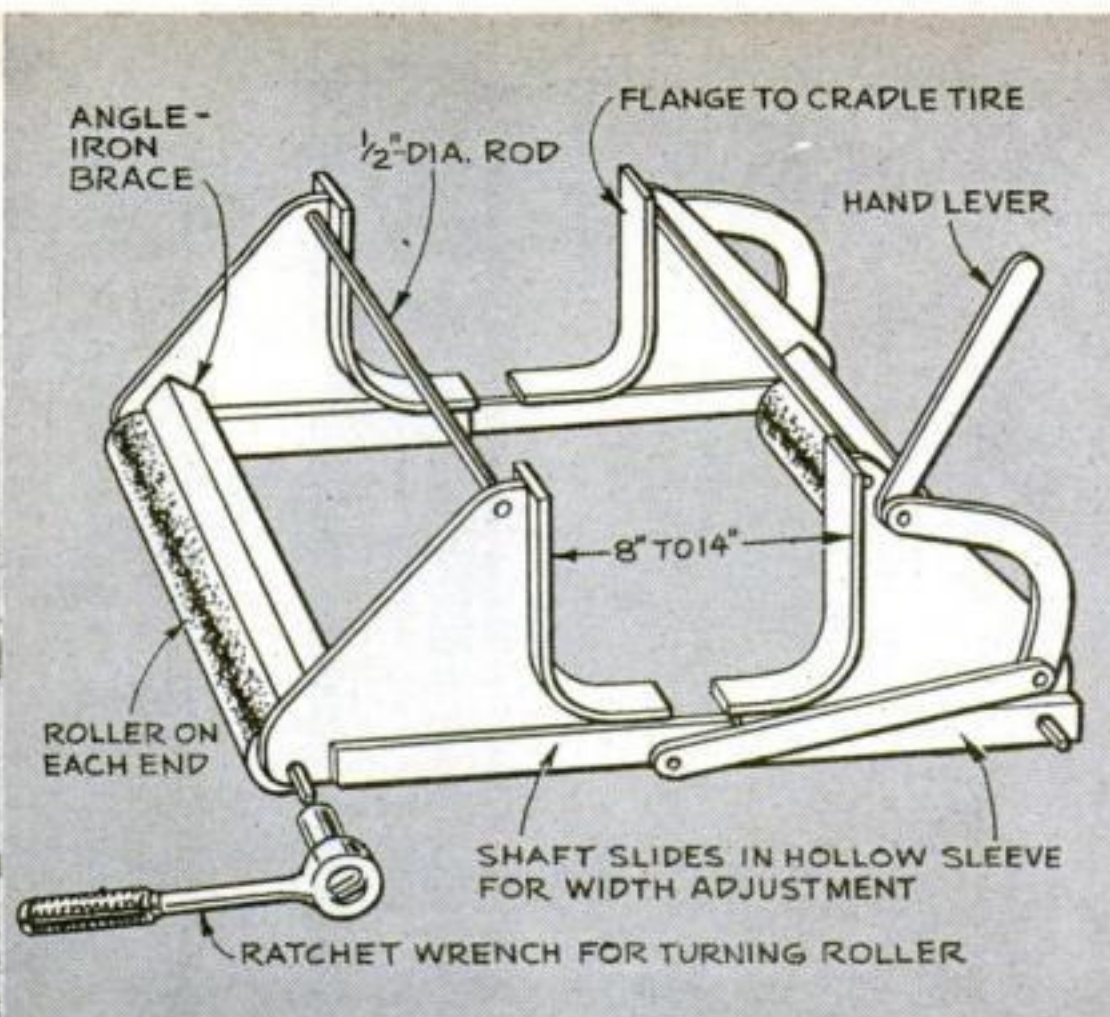
port and rotated to sand the entire rim in one operation. Extra holes for the pin center table tops that have different diameters.



A CUT-OFF MACHINE mounted beneath the bench leaves the top clear for positioning and clamping stock to be cut. Pulling up on the handle raises the blade into the work. Since the blade drops safely below the table when not in use, stock can be fed into the machine without shutting it off between cuts. The photo above shows the machine in position.

Short Cuts and Tips

FROM PS READERS



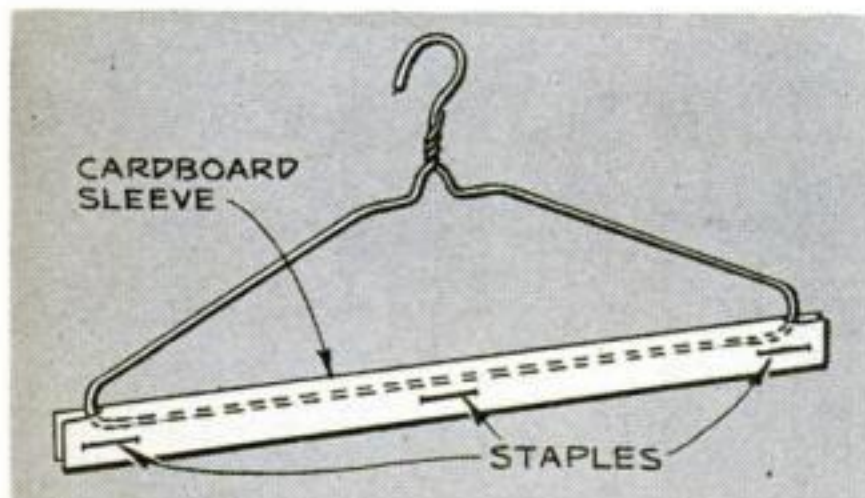
Dolly Holds Tire Erect

STRENUOUS wrestling with truck or tractor wheels is eliminated by this dolly welded from scrap iron. It has rollers from a mechanical corn picker, and moves toward or away from the vehicle

▶▶▶SINKS of stainless steel often have metal stoppers that are too light to stay put. Such stoppers are usually hollow on the underside. But fill this cavity with lead, and the weight helps the stopper seat snugly. Melt a small quantity of

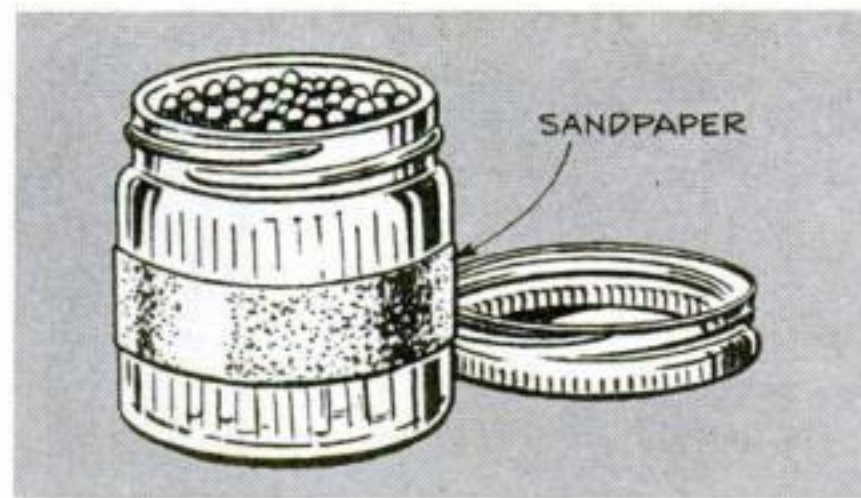
when one of the axles is turned with a wrench. The halves of the stand are joined at the bottom by a shaft that projects from one to ride in a sleeve on the other. This lets you adjust the flanged opening to take various tire widths.—*Harry J. Miller, Sarasota, Fla.*

scrap lead (toy soldiers are fine) in a can over a gas burner or blow torch. Hold the inverted stopper level in a vise and make sure it is quite dry, to avoid being scalded by steam or spitting lead.—*John S. T. Gibson, Kyuquot, B. C.*



Clothes-Hanger Sleeves

THE wire hangers you get from the cleaners usually have a loose cardboard sleeve to pad the crossbar. If these sleeves are only notched over the hanger at the ends, they often drop to the closet floor, leaving the bare wire to put an ugly crease across trouser legs. Three staples will keep the sleeve in place.—*D. O. Van Gilder, Denver, Colo.*



Bottle Your Matches

LONG-STEMMED wooden matches are kept neat, dry, and safe when stored heads-up in a low, wide-top glass jar with a screw-on lid. Snip a 2"-wide strip of sandpaper and glue or staple the ends together to form a circle that will fit snugly around the jar. When this strike plate becomes worn, it's easily replaced.—*F. C. Gardner, San Angelo, Tex.*

How to Repair Plastic Laminates (I)

fix-it file

Notes about the job

Any good floor or furniture polish, or wax, will help restore the gloss to dull spots on the surface. Scouring powder will give satin surfaces freshness.

Clean off surface stains such as crayon scrawls with a waxer-cleaner.

A bad cigarette burn can be dug out and patched with a shellac stick of matching color, applied flush with a hot knife.



THAT gleaming plastic laminate on your kitchen counter or dinette table top will take heavy wear for many years. But accidents—or outright abuse—can leave ugly scars.

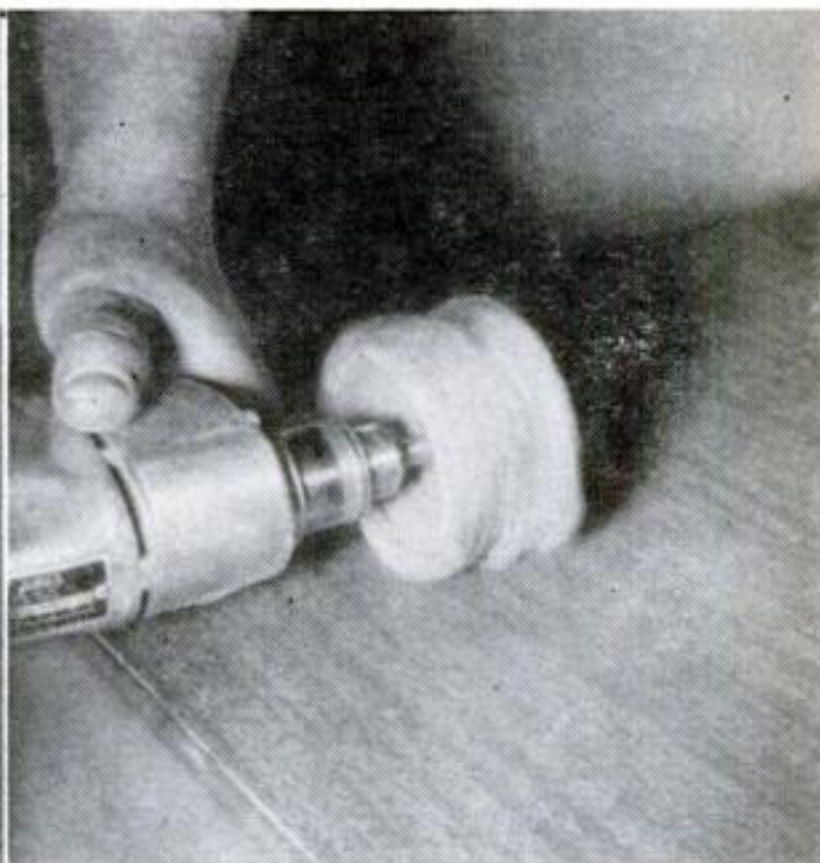
Though laminates are tough and heat-resistant, a cigarette will burn the surface if a draft fans the glowing end

above 275 degrees. Hot skillets or an electric iron can also leave severe burns. Deep scratches can be gouged into a top by a sharp knife slicing food, and clamp-on kitchen tools can chip the surface. Fortunately, repairs can be made with a little patience and know-how.

How to remove light scratches



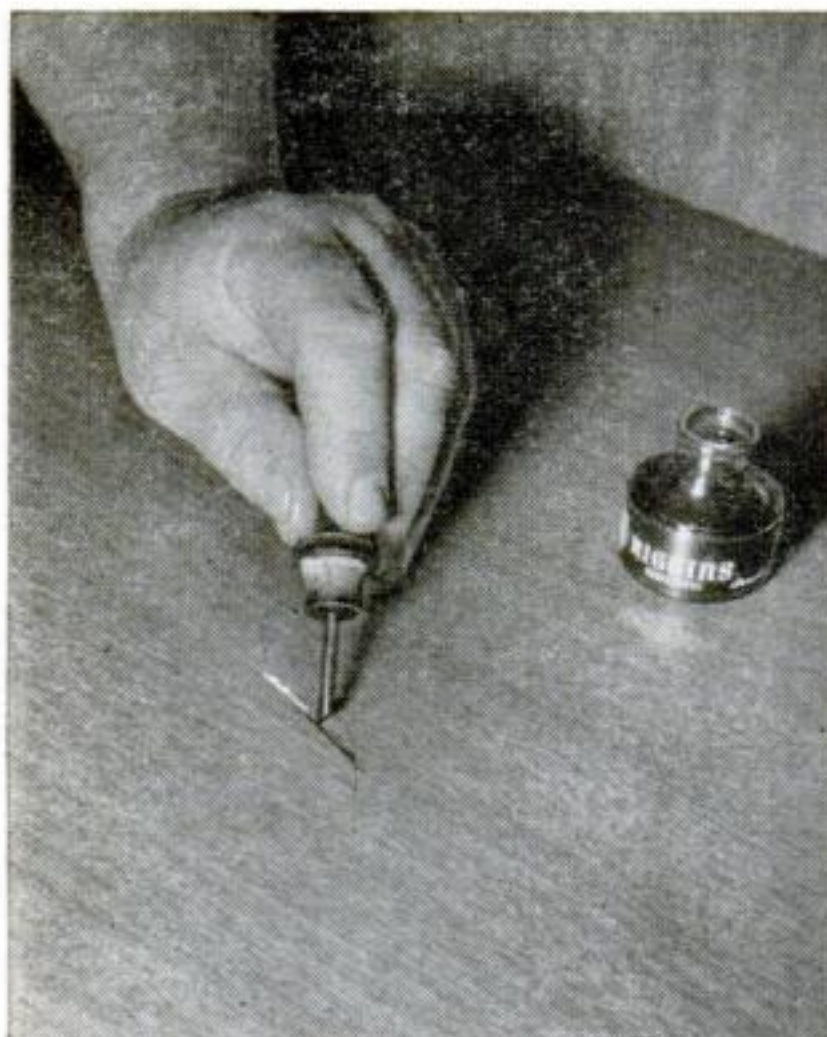
FINE STEEL WOOL or crocus cloth can be used to gently smooth a scratched surface. Wetting the fine abrasive with water will help it cut smooth and will prevent clogging.



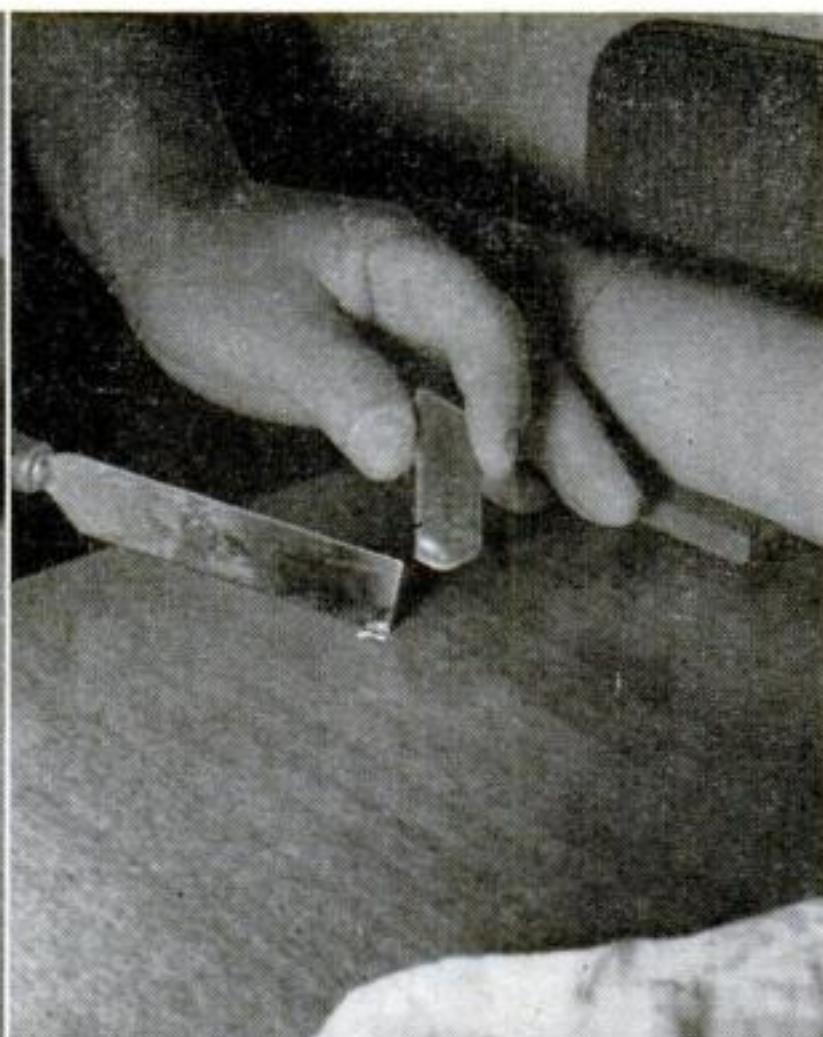
FINISH WITH A BUFFING WHEEL driven by an electric drill. Charge the wheel with jeweler's rouge and work it over the area lightly. Figure on from 10 to 30 minutes for this.

CONTINUED

Deep scratches or burns can be concealed

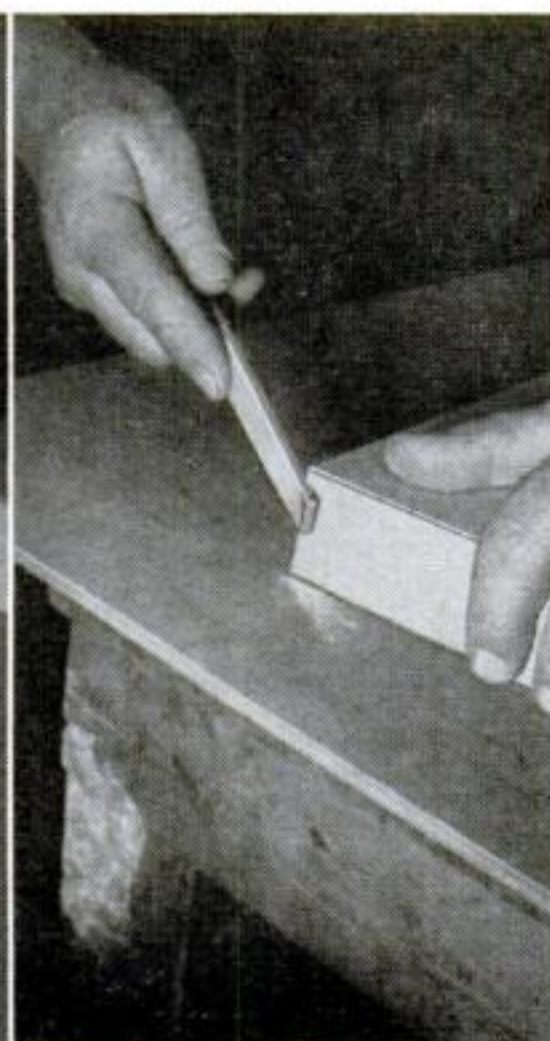
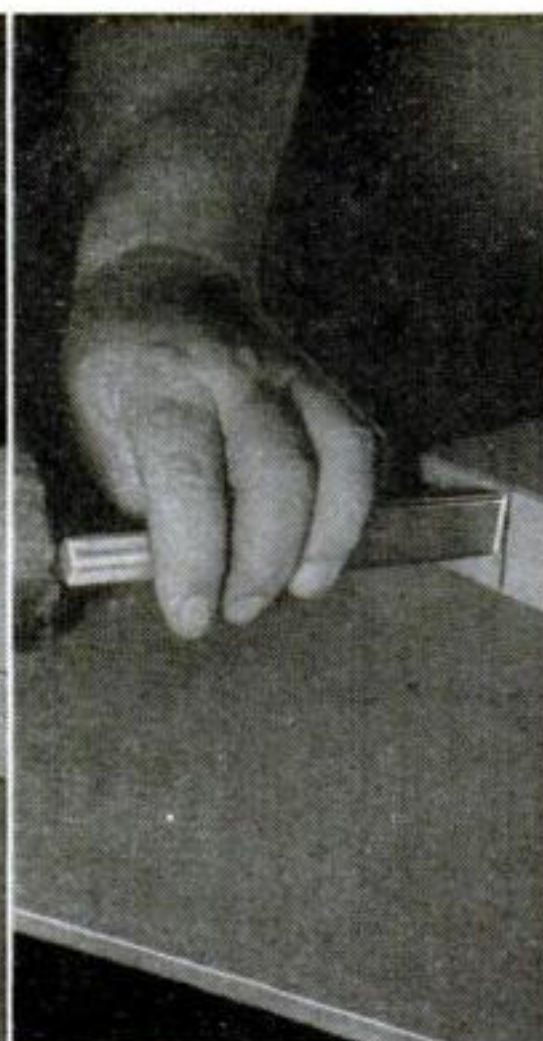
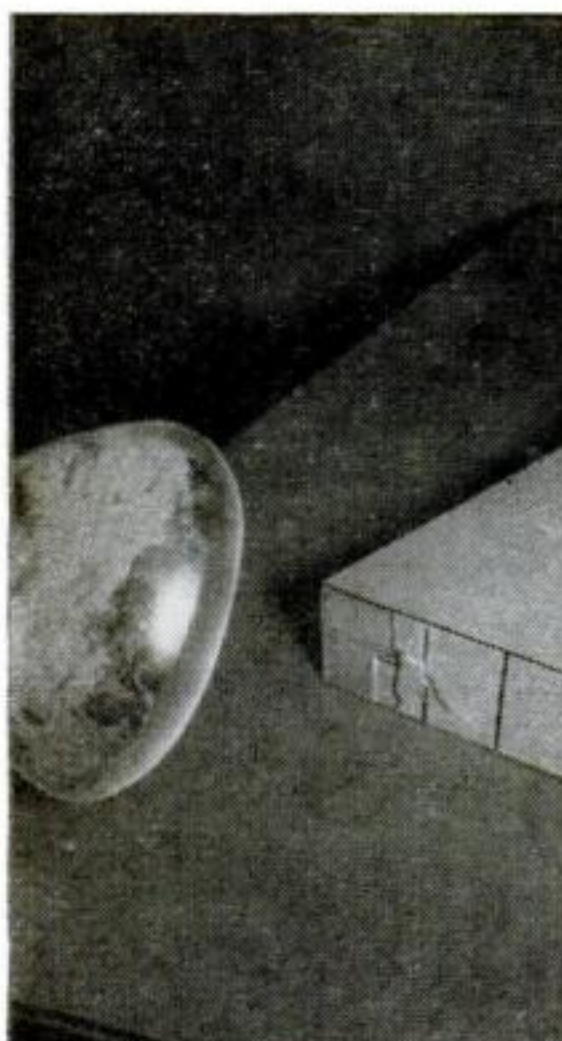


TO TOUCH UP SCRATCHES that can't be polished out, use India ink. You can choose from a wide range of colors. Apply several times to build up enough thickness to fill the scratch completely as well as color it.



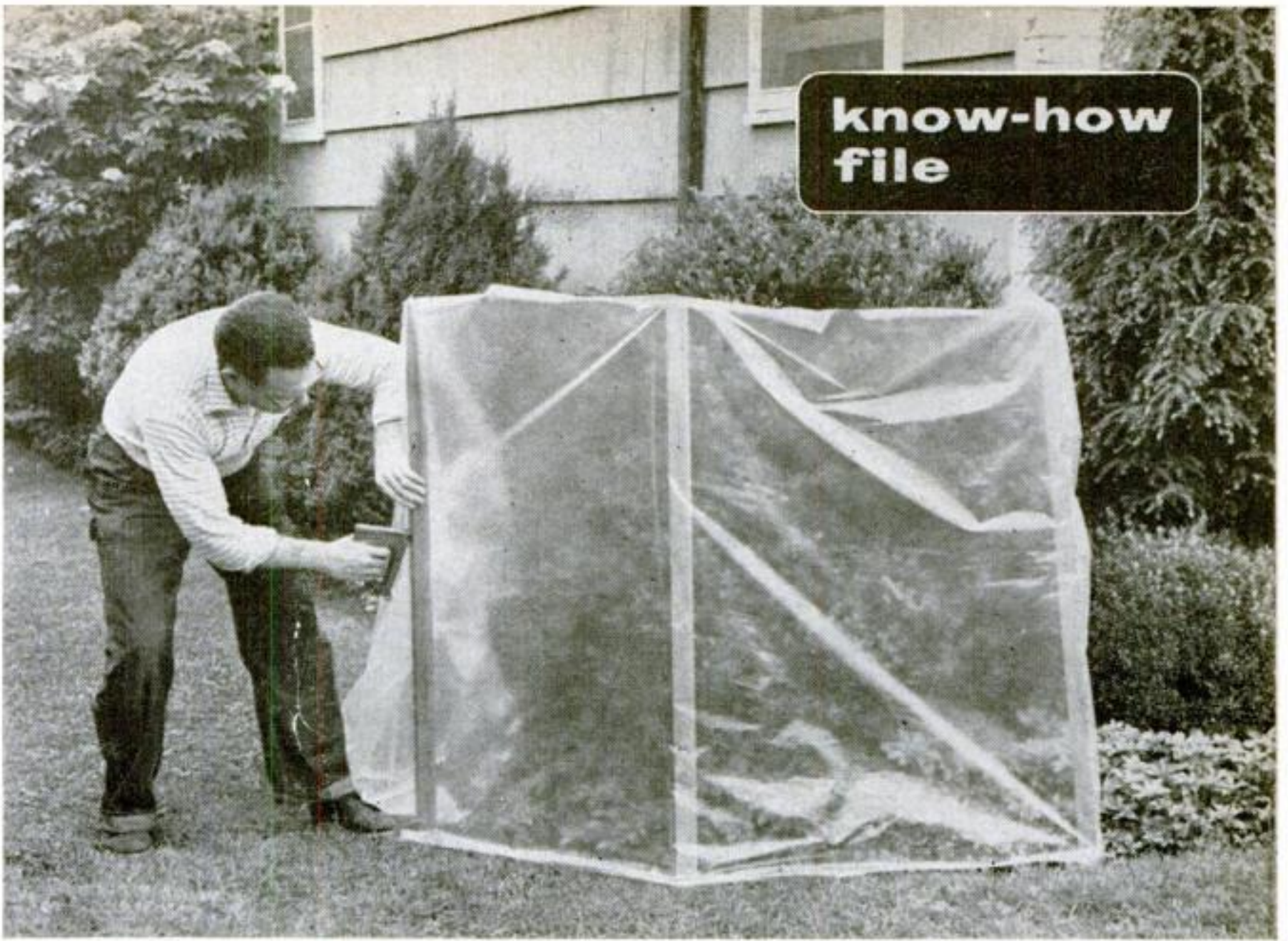
TO FILL DEEP SCRATCHES, nicks, or small burns, use stick shellac of matching color. Apply it and smooth it flush with a knife heated repeatedly with a torch or alcohol lamp. Sand over it lightly and wax.

How to repair damage to the edge



IF DAMAGE IS TOO LARGE TO FILL, the edge strip must be replaced or a patch inserted. Warm the damaged area with a torch or heat lamp (left) to soften the adhesive, then pry off the strip or cut away the damaged part

(center). Cement an oversize new piece in place and dress down the overhanging edges with a file as at right. If necessary, conceal the patch joint by filling it with matching color stick shellac as with deep scratches.



LIGHTWEIGHT STRUCTURES like this windbreak for delicate shrubs are a quick stapling job with polyethylene film. The trick is to wrap the

polyethylene around the stakes at the sides and staple through two or three thicknesses to keep the thin film from tearing.

Polyethylene Film: How to Shape and Fasten It

TOUGH, weatherproof polyethylene film can be put to many new uses around the home if you know how to form it into special shapes. With the proper techniques, the thin plastic sheet can be stitched, tacked, stapled, taped, and heat-sealed to provide rugged, watertight joints.

You can form the film into fitted covers for boats, power mowers, patio furniture, and other odd-shaped equipment. You can frame it to serve as roofs, fences, windbreaks, and moistureproof enclosures.

Although strong, polyethylene plastic does tend to stretch, making it a bit

tricky to handle. The holes around nailheads and other fasteners may become enlarged under strain and pull loose unless care is taken.

You'll also find that polyethylene is difficult to cut accurately with a knife or by ripping. This produces a ragged edge. The neatest way is to lay the material flat and use scissors.

Making strong joints. The secret of using most fasteners with polyethylene is to fold the film several times where two edges are to be joined. The folds keep the plastic from tearing and also produce an almost vaporproof seal.

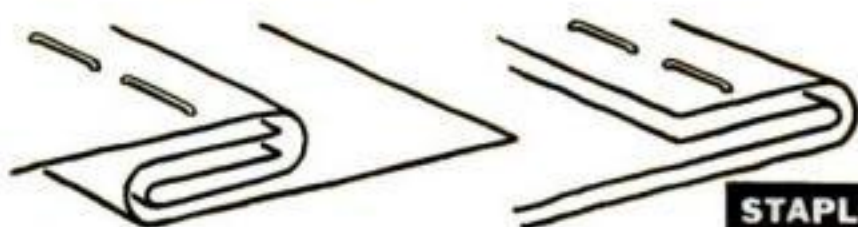
You can run staples through the folded

Five ways to form strong joints in polyethylene film



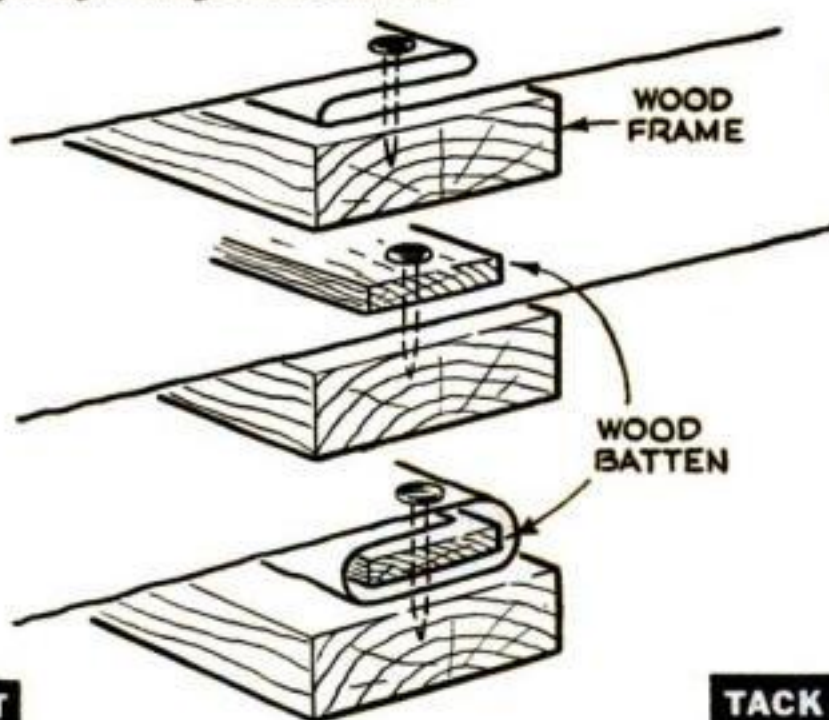
SEW IT

THREAD HOLDS WELL if you take large stitches to avoid making too many holes. Fold edges first so they interlock. For extra strength, use a double row of stitches, staggered so the holes won't line up.



STAPLE IT

STAPLES ARE FAST and make a very tight seam. Where the stapler will reach, use a flat seam, as shown above at left. On large sheets, fold over and hem the edges, then pull the pieces apart, as at right.



TACK IT

ON WOOD FRAMES, take a tuck in the plastic where it crosses the frame and tack through the fold (at top). For greater strength, tack a batten strip over the film (center). At the ends, wrap the film around battens before stapling (bottom).

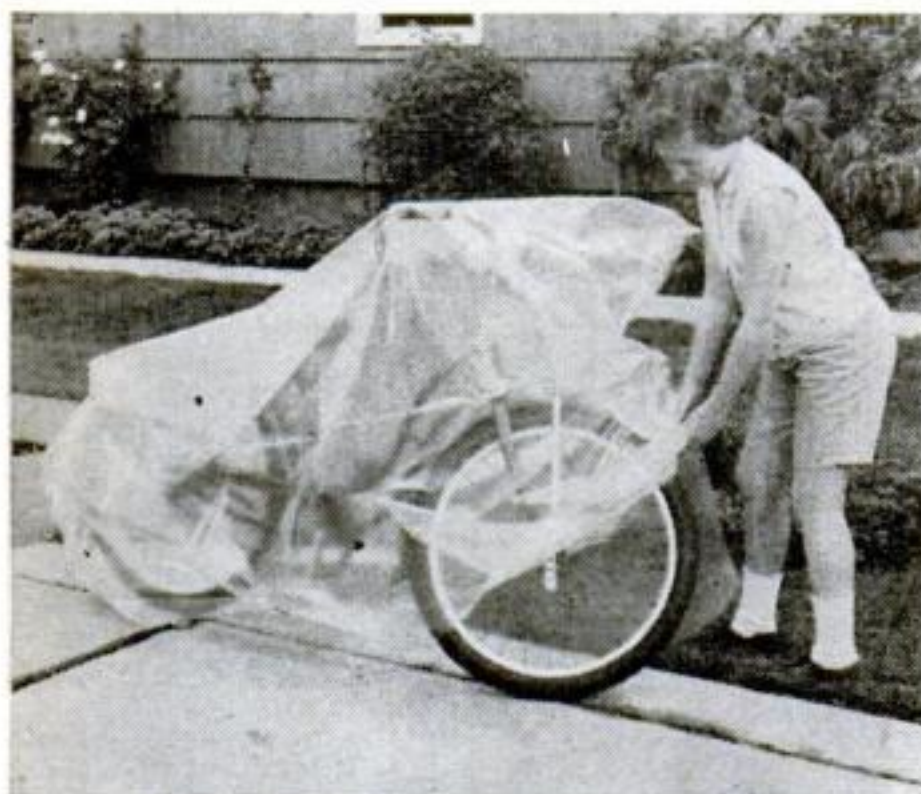
plastic or stitch it like cloth. For sewing, use nylon thread and fairly large stitches. Small stitches put too many holes in the thin film.

For smooth, flat seams, you have two choices. You can tape the joints or heat-seal them together. These make the trimmest-looking seams for bags and fitted covers that need a neat appearance.

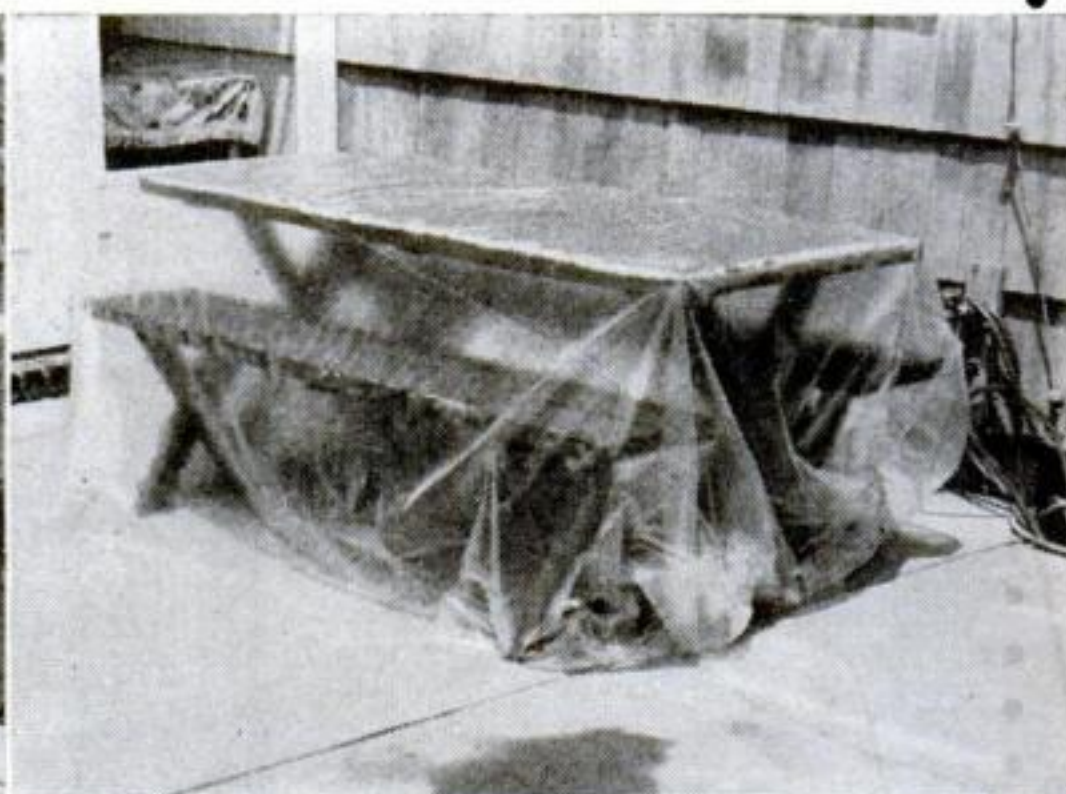
For small or temporary jobs, ordinary

masking tape or plastic electrician's tape will hold well. In this case, you don't fold the seams—just butt the edges together and stick the tape on top. Where you want a big, permanent, moisture-proof seam, use the adhesive-backed polyethylene tape that's made especially for the job. This tape matches the polyethylene sheet and makes an almost invisible joint.

Two inexpensive ways to weatherproof outdoor equipment



LARGE BAGS formed of polyethylene film slip easily over bikes, barbecues, and other odd-shaped yard equipment. The seams can be made watertight and windproof with tape or staples.



QUICK COVERS for outdoor furniture require no fastening if you tuck them in at the bottom to hold them down. If one sheet isn't big enough, it's easy to join small ones yourself.



TAPE IT

FOR A MOISTUREPROOF SEAM, special self-adhesive polyethylene tape is available in long rolls. You just peel off the protective backing and press the tape over the plastic. Use a butt joint under the tape.



SEAL IT

HEAT-SEALING melts the plastic, welding two sheets together. Overlap the edges and sandwich them between two strips of paper. Test the iron first on scraps to find the heat that will just soften the plastic without melting it completely.

Heat-sealing makes a strong and even less conspicuous seam, but it's a slower and more difficult process. Here, you actually weld the plastic together by softening it until it fuses.

Overlap the edges of the film and sandwich them between two strips of heavy, hard-surfaced paper, such as kraft paper. Run a hot flatiron or soldering iron along the top of the sandwich. The paper keeps the plastic from sticking to the iron or the table.

The proper heat must first be determined by trial and error on scraps. Too much heat will melt the film; too little will make a weak weld. If you have to make a lot of such seams, you can buy a commercial bag-sealing iron. This costs \$15 to \$20, but saves its price in tape on big jobs.

Framing the plastic. Polyethylene's extreme light weight can give you trouble when you try to fasten it down. The slightest breeze will pick up a large sheet and float it away unless it's securely anchored. Strong winds stretch the plastic and are likely to pull it loose unless the fasteners are reinforced.

For large covers and enclosures, it's best to wrap the film several times around sticks at the edges, then tack through the plastic into the wood. This weighs down the edges and takes the

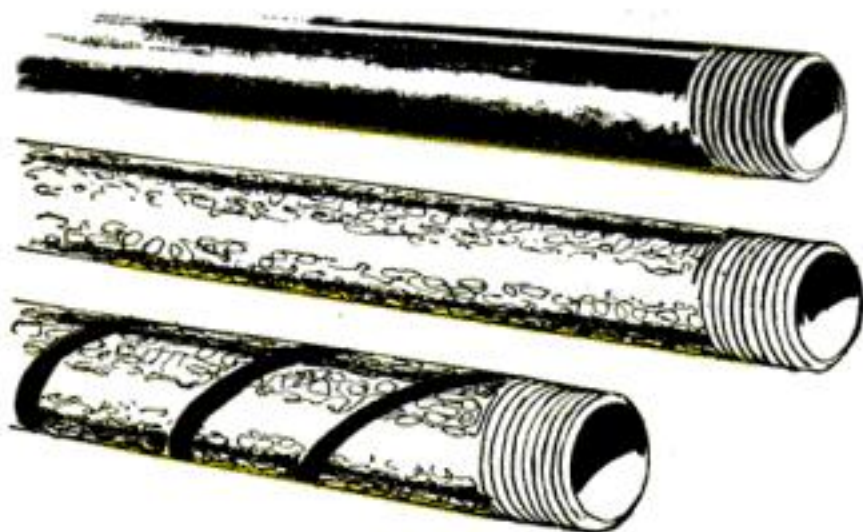
strain off the fasteners so the plastic won't tear. The sticks can be nailed or lashed to stakes in the ground if additional anchoring is needed.

When covering large frames, as for a temporary building, greenhouse, or wind-break, the most secure way is to tack batten strips over the plastic so the film is sandwiched between two pieces of wood. This prevents stretching and tearing. Where two pieces of film join, fold the edges together several times to produce a strong interlocking seam.

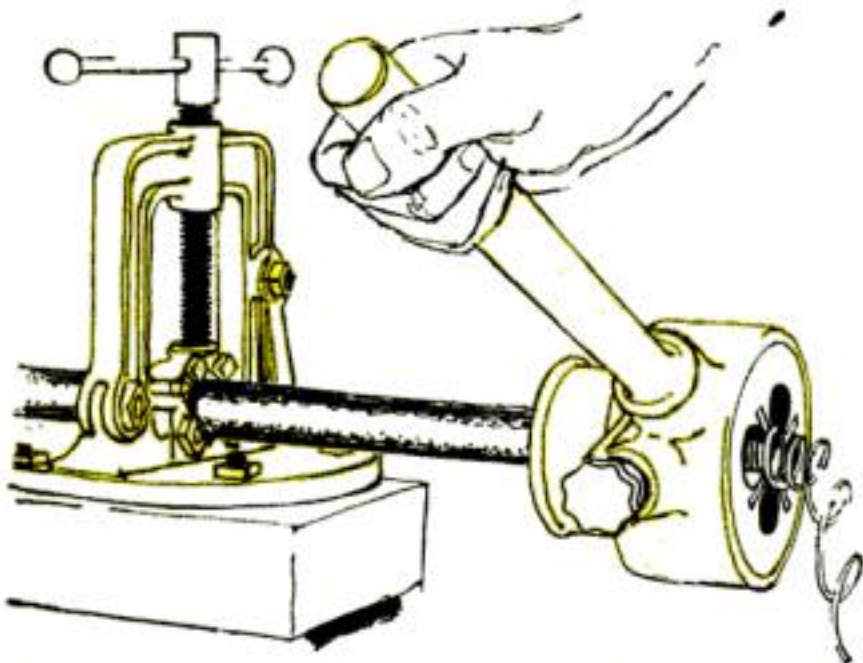
A roof of polyethylene will withstand heavy rains and even snow loads if you slope it sharply to provide good runoff. Place supporting members no more than 3' apart for thin 4-mil film, 4' for the thicker 6-mil type. For maximum insulation as for a greenhouse, add a second layer of film on the inside of the frame.

Where you want to tie the plastic in place, it can be fitted with metal grommets as you would with canvas. The grommets will not withstand a hard sideways pull, but they will allow you to thread a drawstring through the plastic so the edges can be snugged in tight around irregular-shaped objects such as a boat or yard equipment. Running tie-downs across the tops of covers or structures will also help hold them down against winds that get in underneath.

A Plumber's Tips for Working Galvanized Pipe



USE THE RIGHT PIPE for the job. For drinking water, galvanized is a must, never black pipe, which rusts quickly. For pipe in or under concrete, galvanized wrought iron is better than steel. It looks like galvanized steel, but has a red barber-pole spiral around it.



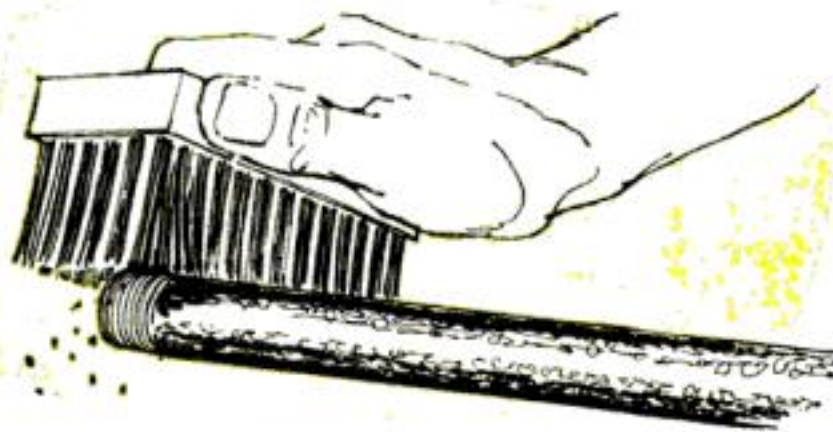
KEEP THREADS SHORT when you make joints or the pipe will extend too far into the fitting, forming a deposit-catching obstruction. Run up the die just flush with end of pipe.



DON'T BUY USED PIPE unless you're sure it formerly carried water. If it's free of deposits inside, that's a tip-off it was used for gas, which will give water an unpleasant taste.



DON'T BE FOOLED by the ease of using a large wrench on small pipe. You may split the fitting or run in the pipe too far. Use a 10" wrench for $\frac{1}{2}$ " pipe, a 14-incher for $\frac{3}{4}$ " and 1".



MARRED OR DIRTY THREADS make poor joints. When you lay pipe on the floor or ground, block it up to protect the ends. Clean clogged threads with a wire brush before assembling.



APPLY JOINT COMPOUND to male threads only. On female threads, it forms hardened lumps, causing obstructions or plugging of valves. This compound is a lubricant, not a sealer.

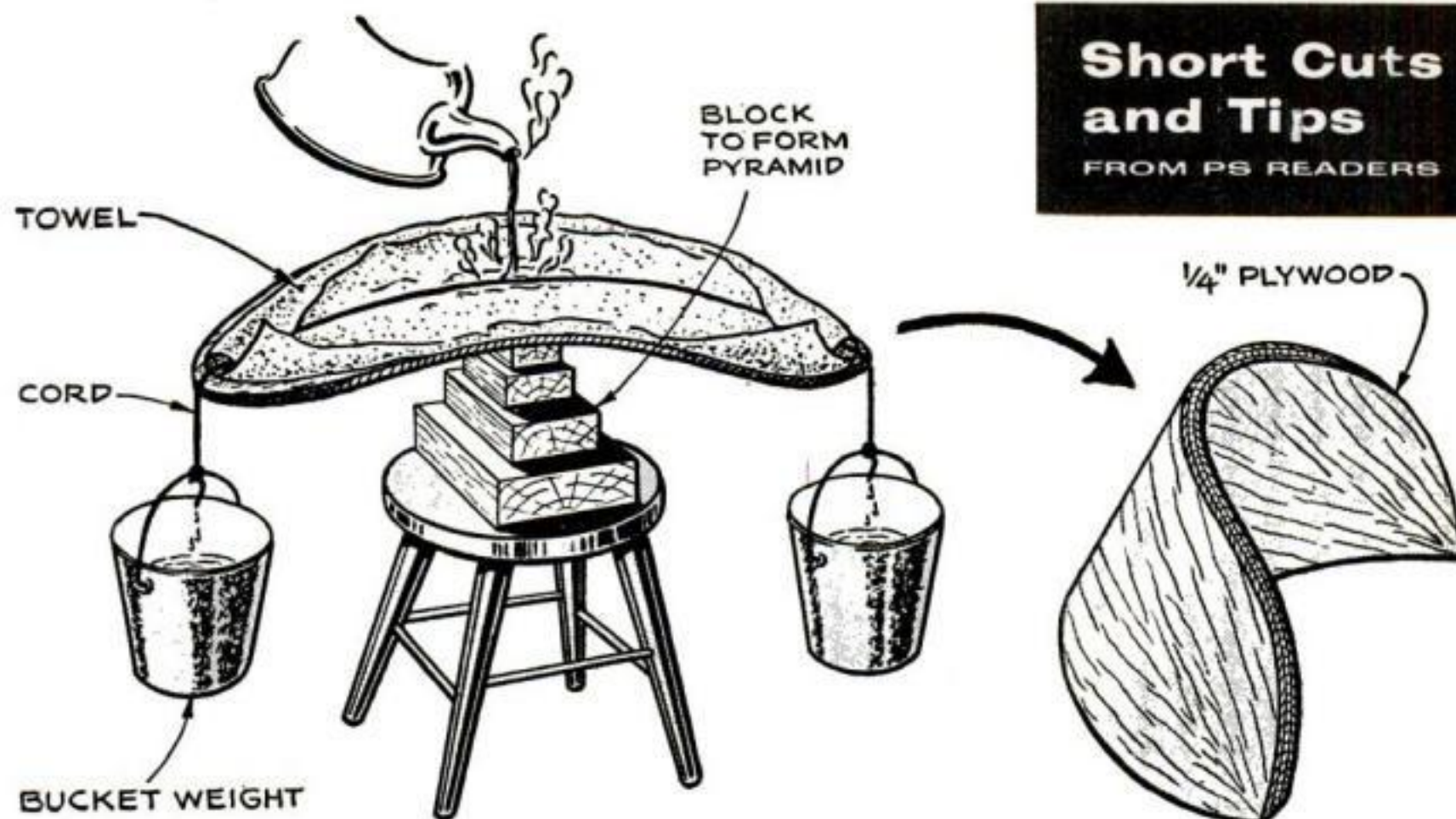


PIPE WON'T TWIST as you screw on new lengths if you use a second wrench in the opposite direction to lock the pipe. This "backing wrench" makes it easy to get each joint tight.

—Lloyd Weaver, Phoenix, Ariz.

Short Cuts and Tips

FROM PS READERS



Bucket Sling and Hot Water Form Plywood into Curve

TO MAKE a shield for my water scooter, I had to bend a 19"-by-37" piece of $\frac{1}{4}$ " marine-grade plywood into a semicircle with a radius of 12". I tied a bucket to each end of a clothesline hung across the long dimension, with a heavy towel underneath. I folded the corners of the towel over to funnel runoff into the buckets, which were about one-third full of

water. At intervals, I poured boiling water at the top of the curve (about six quarts in all) to keep the plywood hot. It soaked the towel and drained into the buckets, increasing the tension. When the plywood had a 180-degree bend, I tied cord around it and removed the bucket sling and towel to let the wood dry.—*Richard Todd, Hoyt Lakes, Minn.*



Long-Distance Painting

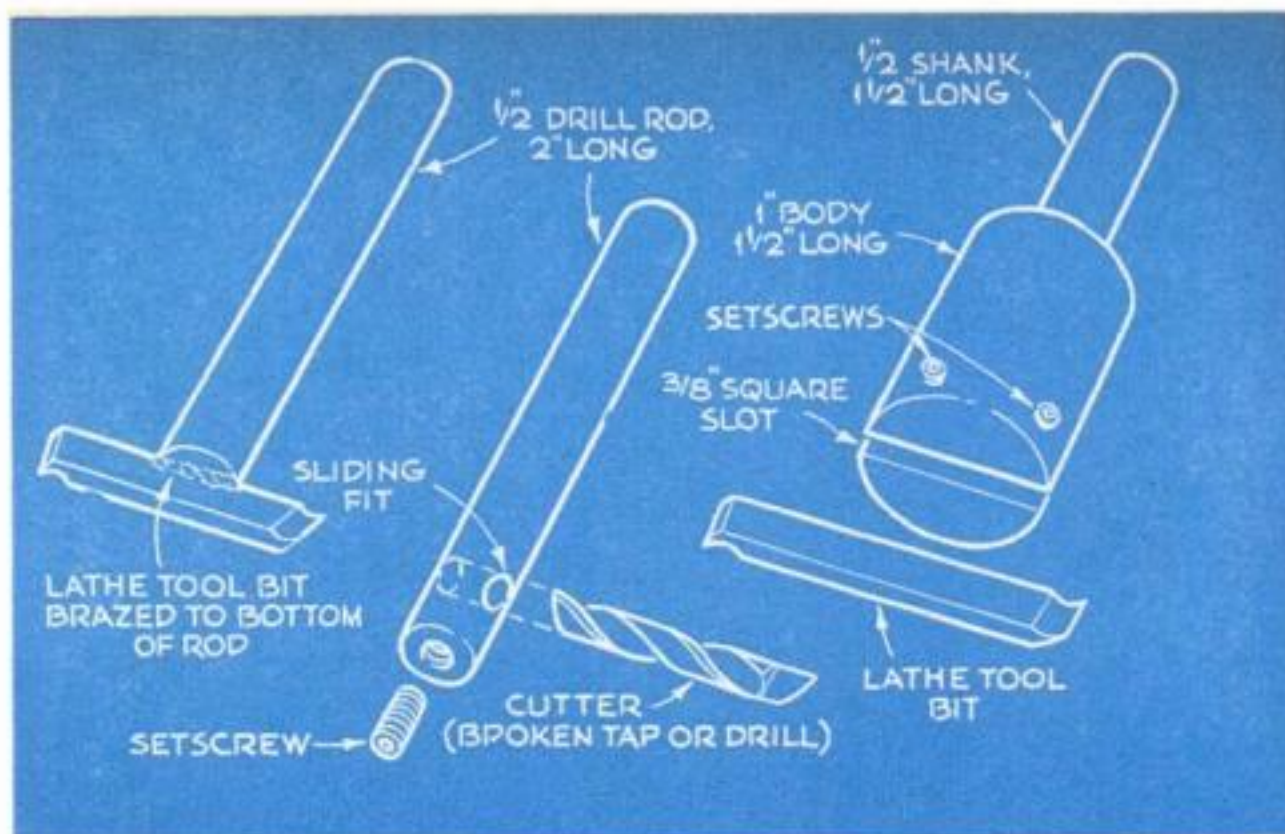
WANT to touch up an out-of-reach spot without dragging out the stepladder? Extend your brush's handle by C-clamping it to the blade of an ice scraper or hoe.—*John Bahr, Ithaca, N. Y.*



Disposable Wastebasket

NEED an extra wastebasket in a hurry? Fold the top of a grocery bag inside several times to stiffen it. Attach one side to a wall, door, or desk with masking tape. When the bag is full, just pull it off, close the top, and throw it away.—*Wayne Floyd, Fayetteville, Tenn.*

One MACHINIST tells another...



...For Big Holes, Make Your

DRILLING large holes in tough metals is a problem for most small shops. Boring in a lathe is one solution, but it's slow and often not adaptable to the work. Large commercial drills are expensive and the machines to use them not usually available.

The drills sketched above are designed for use in smaller machines—drill press, lathe, or milling machine. With them you can drill holes up to 2½" in diameter without strain on your machinery or pocketbook. Construction is easy and requires no tricky heat treatment.

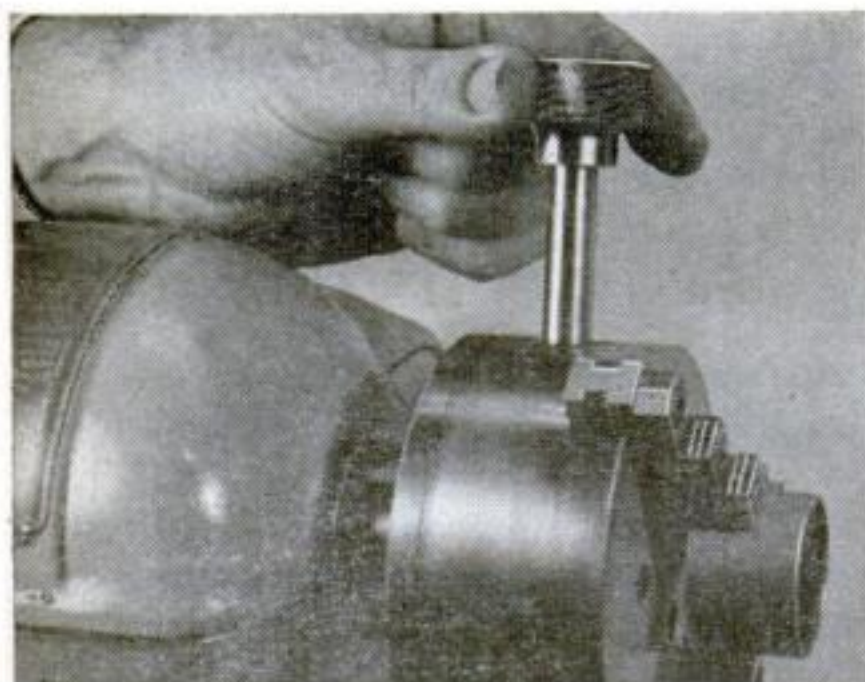
The simplest is made by brazing or silver soldering a piece of ¼" lathe tool-bit steel to a length of ½" drill rod. Center the bit accurately before brazing to avoid excessive grinding later to equalize the cutting edges. After brazing the

tool, quench it at once in clean water.

Another type uses a broken tap or twist drill for the cutter. Use ½" drill rod for the shank. Drill a cross hole near one end, making it a sliding fit on the broken tap or drill. Drill and tap for a setscrew to secure the cutter.

The third-type spade drill is a little more sophisticated. The same shank will accept a wide variety of cutters. Turn the shank as shown in the sketch. Mill (or saw and file) a slot across the large end. Drill and tap for setscrews. When using cutters considerably smaller than the slot, shim equally on both sides so the cutting lips will be equidistant from the shank centerline.

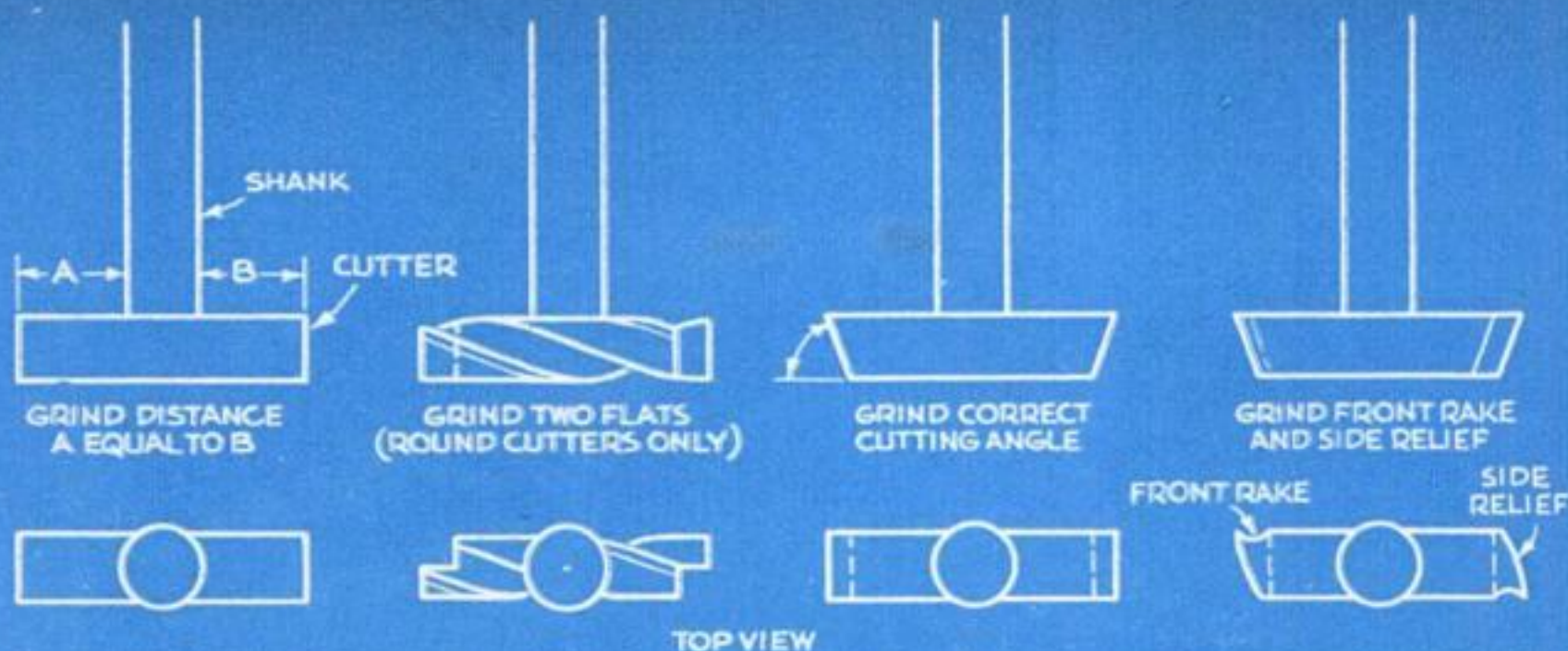
No hardening is needed for any of the cutters described—they're prehardened tool steel. Use high-speed steel tool bits



Wrench Saves Fragile Work

THIN-WALL tubing and similar fragile work is easily crushed or distorted when chuck jaws are closed too tightly. This thumb-knob chuck wrench permits a very sensitive "feel," gives more accurate control of chuck-jaw pressure and thus prevents overtightening.

Turn down the wrench shank on the lathe and knurl the knob. Square the end of the shank on the milling machine, or file to shape. Give the wrench a light case hardening for greater durability.—H. J. Gerber, Stillwater, Okla.



Own Drills

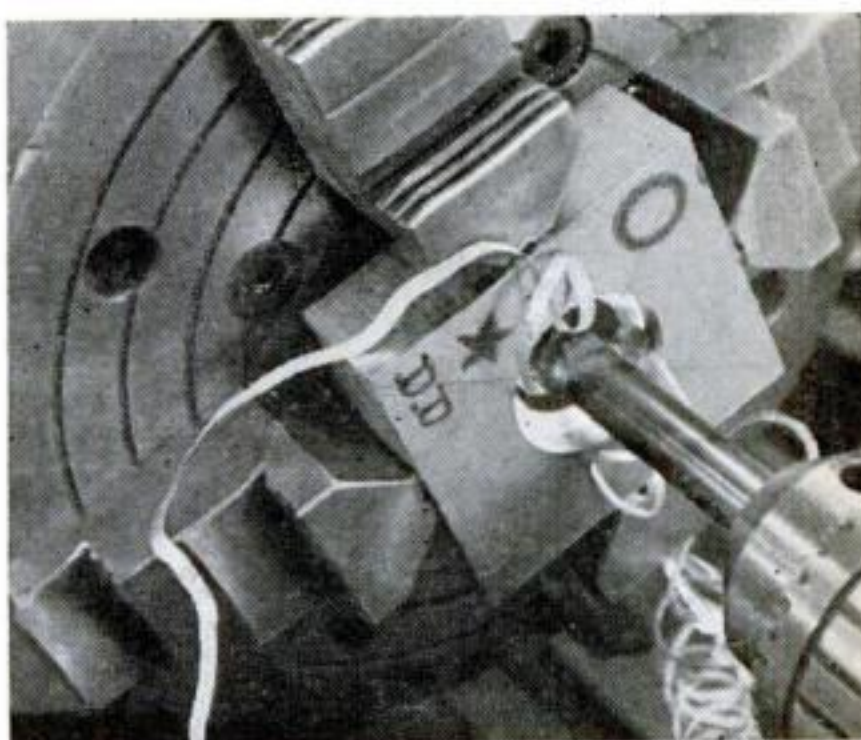
for brazed tools. It won't be softened by ordinary brazing temperatures.

Grind your tools to shapes shown, using a medium-grit wheel. Use light pressure and quench frequently to avoid burning the cutting edges. Check length of lips with a steel rule. Be sure they are equal. Size the drills so that the forward edge of one will just enter the hole made by the preceding smaller drill. Correct cutting angles are shown in the chart. Check with a protractor. Relieve the cutting edges slightly so the drill doesn't rub or chatter during a cut.

To start holes in solid steel, first drill with a standard $\frac{1}{2}$ " bit, then with the next size spade bit, and so on, until you get the desired size hole. Use slow spindle speeds, light feed, and plenty of cutting oil.—*Norman Fried, Los Angeles.*

GRINDING TABLE

CUTTING ANGLES	SIDE RELIEF	FRONT RAKE	MATERIAL
60°	12°	5°	Steel
50°	12°	8°	Soft Metals
30°	15°	12°	Plastics

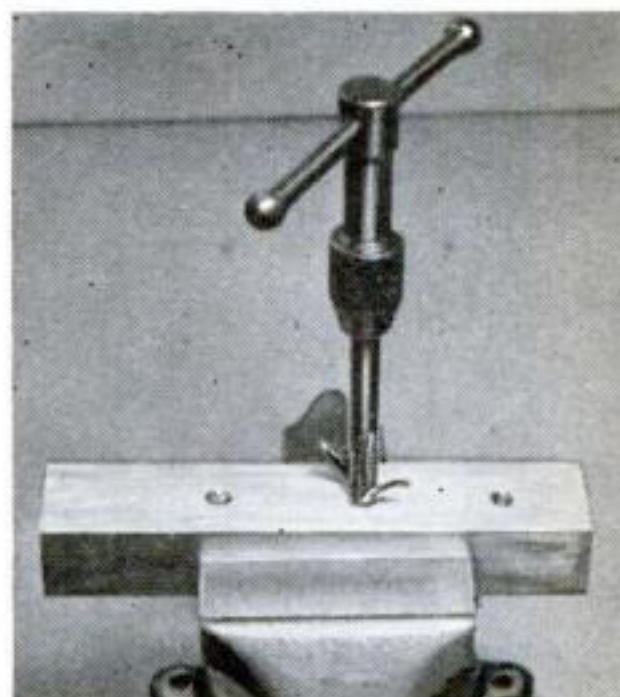


TWIN-SPIRAL CHIPS produced by this $\frac{3}{8}$ " cut are a good sign of correct drill sharpening.

Tap Blind Holes Safely and Quickly

HERE'S a way to avoid broken taps and save time when you're tapping blind holes in metal. Instead of backing the tap out several times during the operation to clear chips, you can cut the full depth of threads in one pass.

All you do is put a birthday-cake candle in the hole and break it off level with the surface. When the tap starts threading, the wax is forced out through the flutes, carrying all the chips with it. The wax is also an excellent cutting lubricant for aluminum, brass, and cast iron. Use one candle for sizes up to $\frac{1}{4}$ ". For larger sizes, force two or more candles into the hole.—*Robert Micals, Freehold, N. J.*



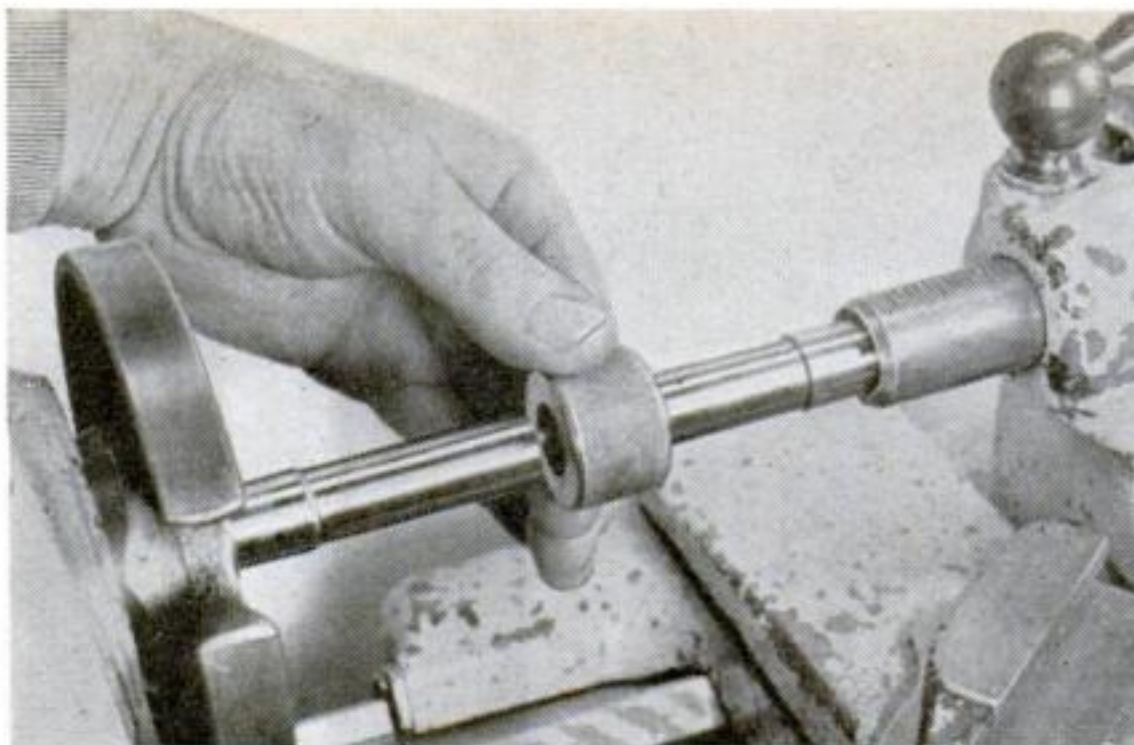
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Centering Plugs Aid Alignment of Lathe Centers

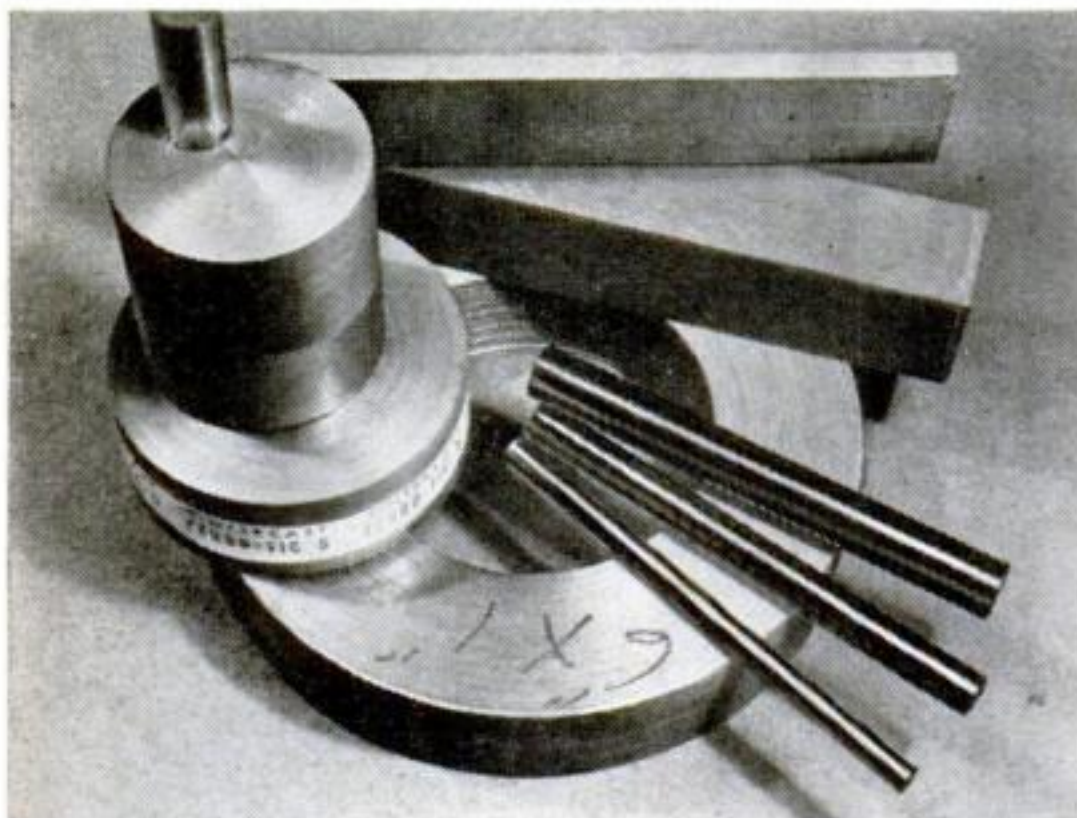
A PAIR of accurately made alignment plugs with a snug-fitting gauging ring will greatly assist making a quick and accurate alignment of lathe head and tail spindles.

Make the centering plugs with taper shanks to fit the lathe spindles. The body diameters can be any convenient size as long as they are identical, perfectly straight, and smoothly finished. Bore the ring gauge and lap it to a snug sliding fit on the plugs.

To use the centering plugs, drive the taper shanks tightly into their respective spindles. Slip the ring gauge on the body of one plug and then adjust the tailstock offset until the ring will slip with ease from one plug to the other.



A word of caution: Run the headstock spindle for a few minutes to warm up the bearing and the lubricating oil before making the test. Many lathes are made with the head spindle a few thousandths low when the bearings are cold. Normal warmup will raise the centerline and thus compensate for this intentional difference built in by the maker.—H. J. Gerber, Stillwater, Okla.

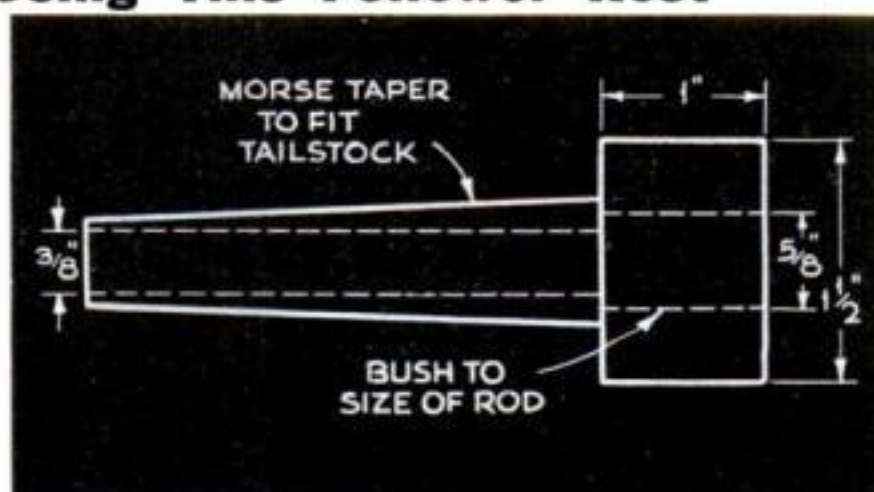


Do-It-Yourself Carbides Can Be Machined

CARBIDE parts and tools to withstand high temperature or corrosive conditions can now be produced right in your shop. Only conventional tools are needed. Prepared by powder metallurgy, these new stainless-steel-bonded, machineable carbides are available in many sizes and shapes. For more information, write to Sintercast Div., Chromalloy Corp., 132 Woodworth Ave., Yonkers 2, N. Y.

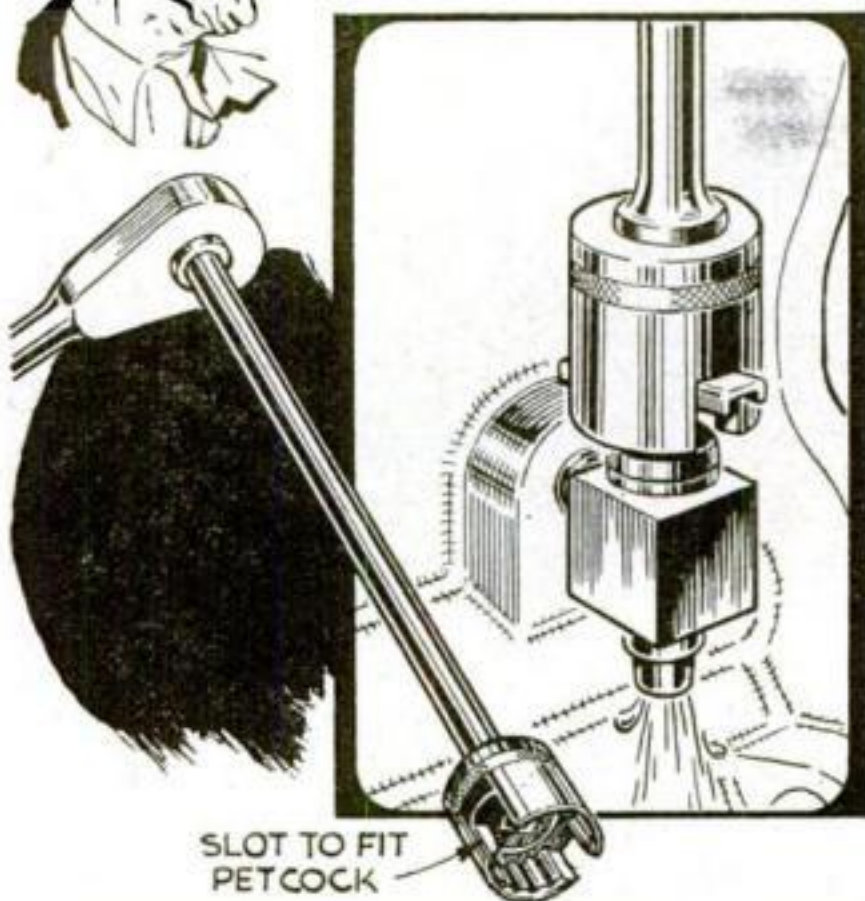
Slender Rods Can Be Turned Using This Follower Rest

THIS easily made follower rest for the tailstock eliminates the tendency of small-diameter work to bend away from, or climb, the tool. Turn the tapered sleeve as shown and make up a set of bushings to fit any size CRS up to $\frac{3}{8}$ " in diameter. Always cut from left to right, using the movement of the saddle to push the tailstock along the ways, when using the follower rest.—Robert Beasley, Detroit.

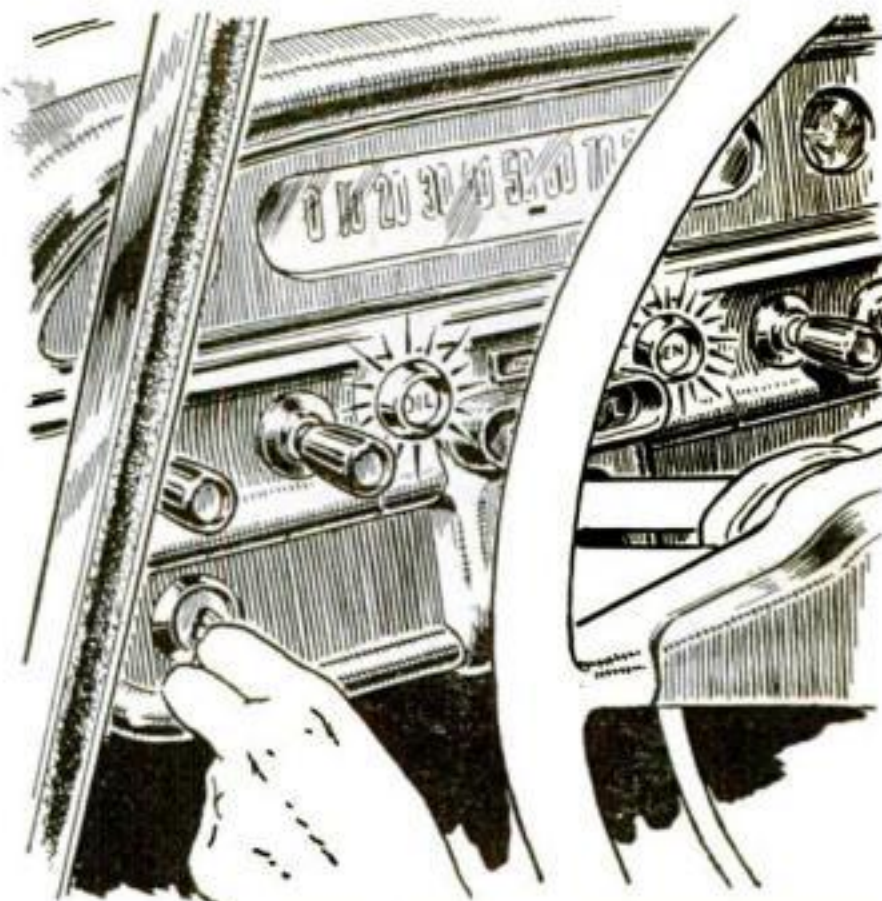




Hints from the Model Garage



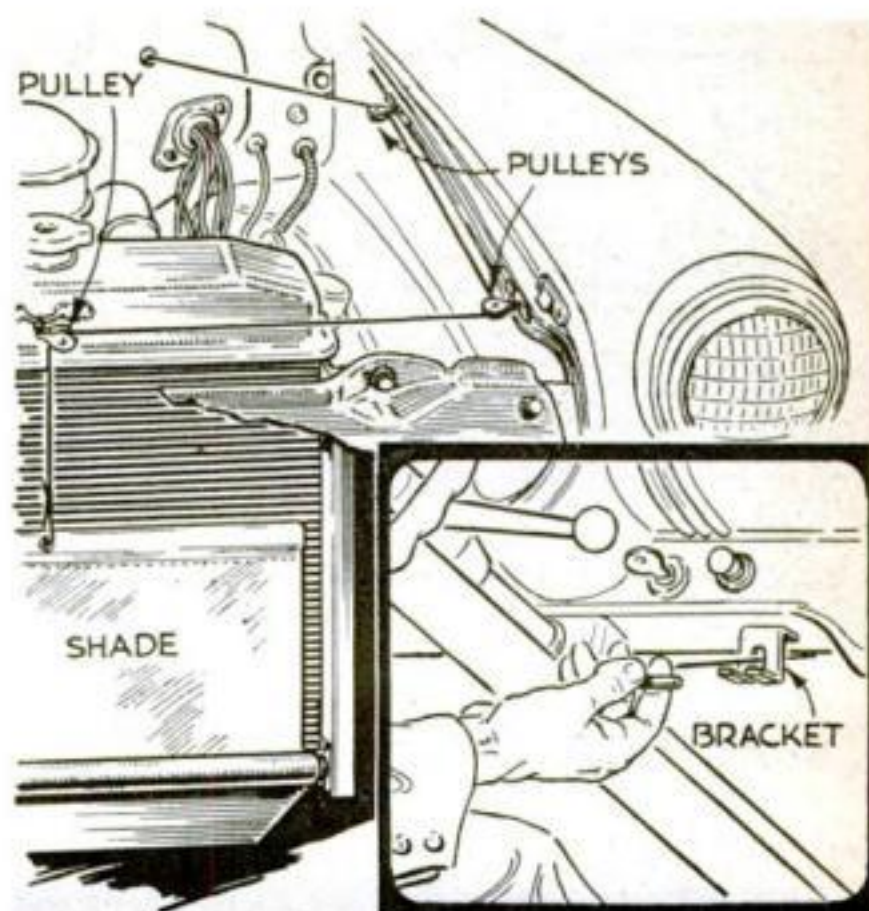
Hard-to-reach petcocks can be turned easily with an old $\frac{9}{16}$ " or $\frac{5}{8}$ " socket slotted and mounted on a long handle extension. Water won't run up your sleeve, either, as you open block drains. Cut the socket to fit the drain handle.



Check the lamp bulbs of your generator and oil-pressure indicator lights by noting whether they light just before the ignition key is turned to the start position. Should one fail to light, you'll know that bulb or sender is not operating.

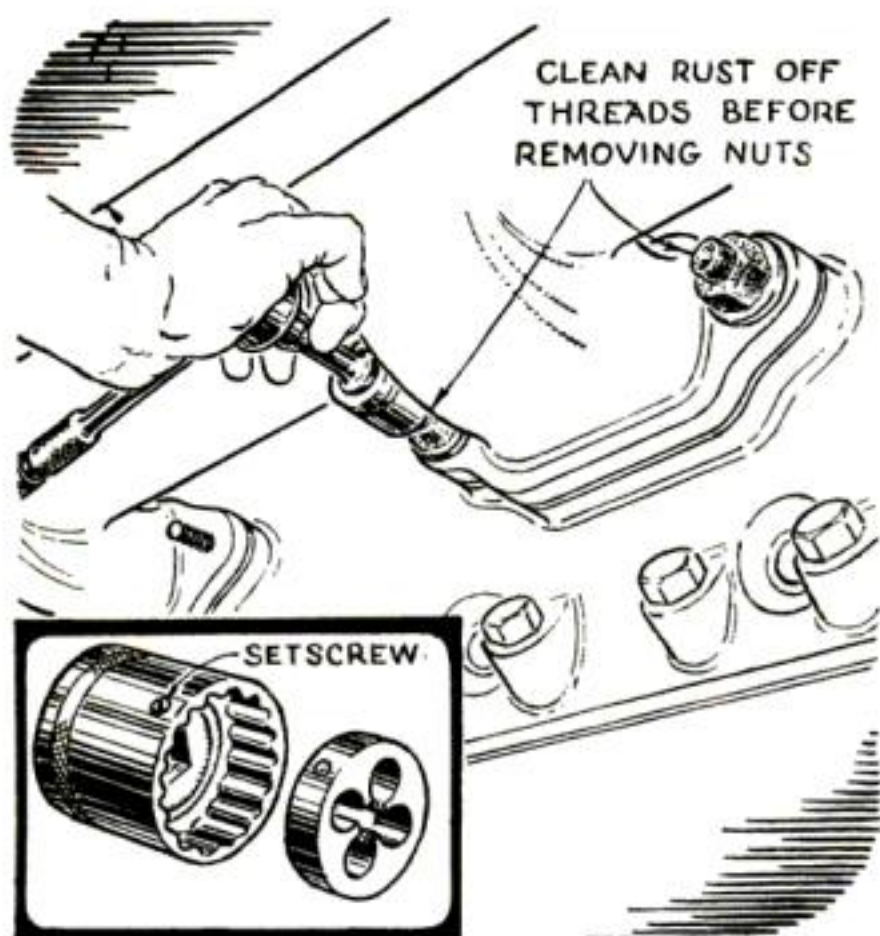


When installing new brushes in a generator, rub the corners on sandpaper to bevel them as shown. This will help the brushes to seat themselves quickly against the slightly worn surface of a commutator that has not been turned.



Hasten warm-up with a window shade in front of the radiator. You raise it by pulling a string run through pulleys to a bracket under the dash. Solder the pulley hanger to the front of the radiator; bolt the others in place.

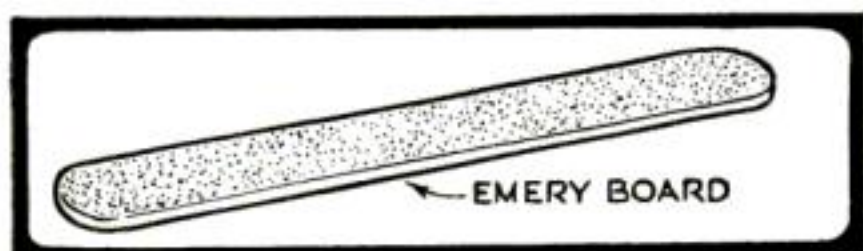
More Hints from the Model Garage



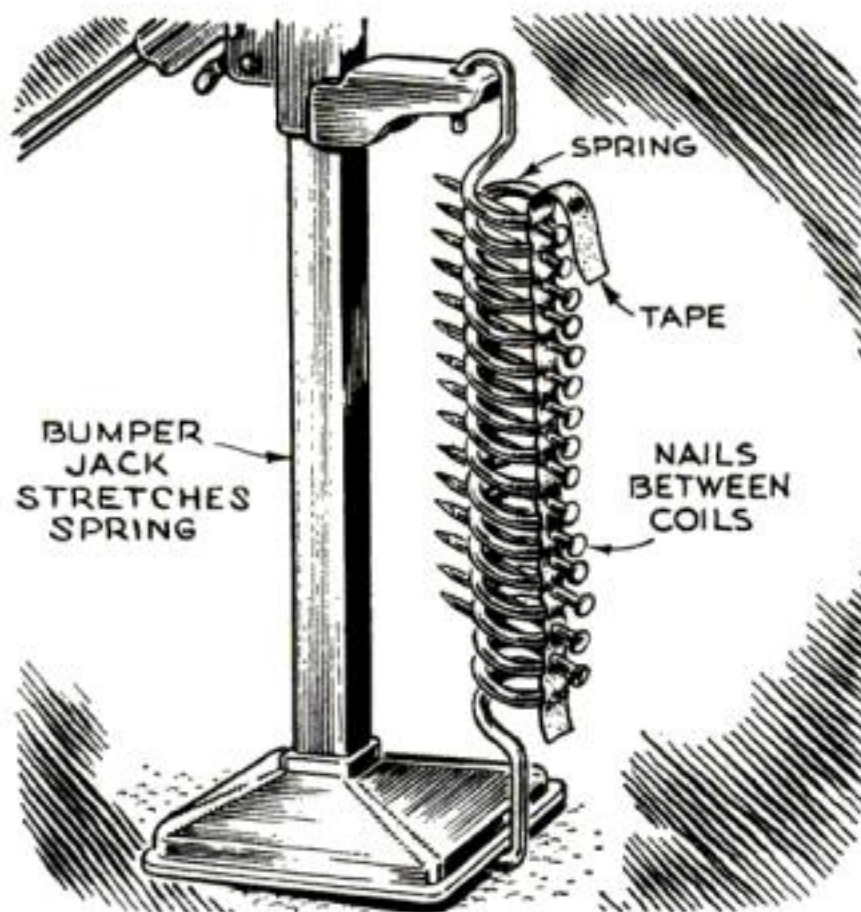
When backing off manifold nuts, rust on exposed threads often jams a nut half-way off the stud. To avoid this, clean the threads with a die *before* removing the nuts. A socket fitted with a setscrew makes a long-reaching die holder.



Tall antennas used with two-way or "ham" radios are difficult to see at night when you're passing under bridges or low-overhead openings. A bit of reflective tape wrapped around the tip will make it easier to judge clearance.



Weather-hardened wipers that smear the windshield can be made to wipe better temporarily. Remove the glaze along the edge with an emery board, nail file, or sandpaper. But remember to replace such wipers as soon as possible.



Installing hood springs can be made easier if you first stretch them and slip nails through masking tape to keep the coils spread. After attaching the springs, lower the hood slightly to stretch them and pull the tape to release the nails.

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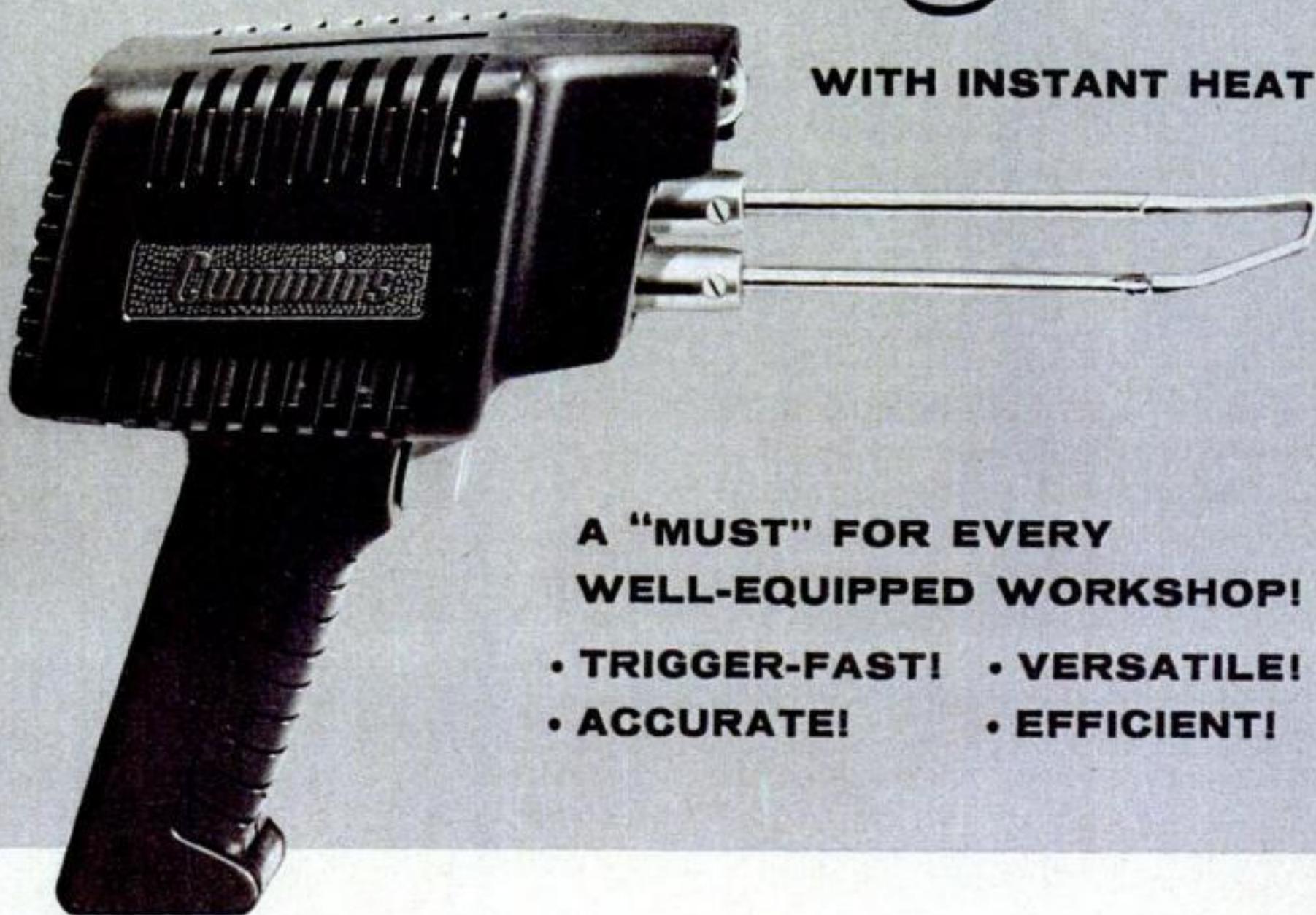
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New from Cummins! A "tip secret" professional soldering gun with quality and performance... versatility and operating ease for professional or amateur electricians, TV, radio and auto repairmen, home craftsmen. Its revolutionary high-resistance tip re-tins simply by wiping the tip, while hot, with a dry rag... no need to discard or file tips. It's ready for action in a jiffy to handle any soldering job from the simplest to the most ambitious!

Just press the trigger — Cummins Solderguns provide instant heat concentrated at the tip. A large, dependable lamp spotlights the job with shadowless light for fast, accurate work. For added convenience, a handy storage compartment at the base of the pistol-grip handle stores additional solder. Cummins Solderguns are double insulated for complete safety; rubber-insulated two-conductor cord provides greater protection should hot tip accidentally touch the cord.

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Soldering Tip

Standard tip for most soldering applications.

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Smoothing Tip

For sealing, melting, raising dents or nicks in wood, repairing scratches, applying thermoset veneer to plywood edges. No. 24349

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Cutting Tip

For cutting plastic and asphalt tile, burning designs or names in wood, removing old putty from windows.

No. 24347

\$1.25

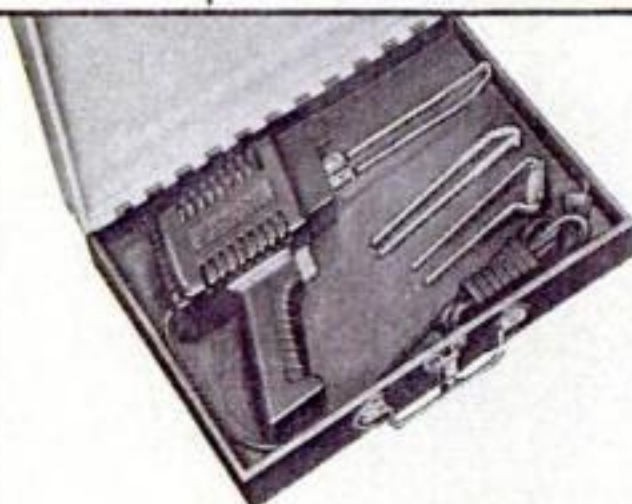


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Buy ANY of these Cummins Tools at the regular price . . . get a \$5.50 metal carrying case for **ONLY 88¢ EXTRA!**

Put Cummins "Pay-Off Power" to work — and you'll find how fast it "pays-off" in time and labor savings on scores of tedious, time-consuming jobs! Quality Cummins Tools are built to professional standards, priced for everyone . . . designed for the utmost in performance, handling ease and safety with exclusive Cummins features!

CUMMINS 466-11 DELUXE SABRE-JIG SAW — NO VIBRATION, thanks to automotive cam drive. Combines all features of rip, crosscut, band, key-hole, hack, jig and scroll saws. Hairline precision in cutting plywood, plastics, leather, metal. Ideal for home workshop, plumbers, electricians, pattern makers, carpenters, heating installers.

Reg. Price \$44.95
Deluxe metal case . . \$0.88 (A \$5.50 Value)

(Ordinarily you'd pay \$49.95 for saw and case!)

CUMMINS 469-01 ORBITAL SANDER — Direct-drive powerful induction motor with exclusive balanced counterweight assures long life, vibration-free sanding. Easy abrasive change, removable auxiliary handle.

Reg. Price \$39.95
Deluxe metal case . . \$0.88 (A \$5.50 Value)

(Regular price of Sander and case is \$44.95)

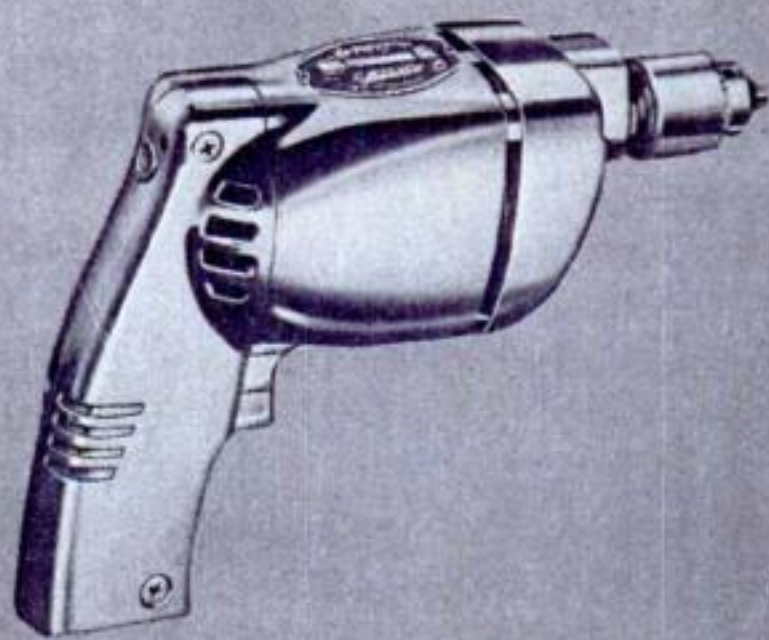
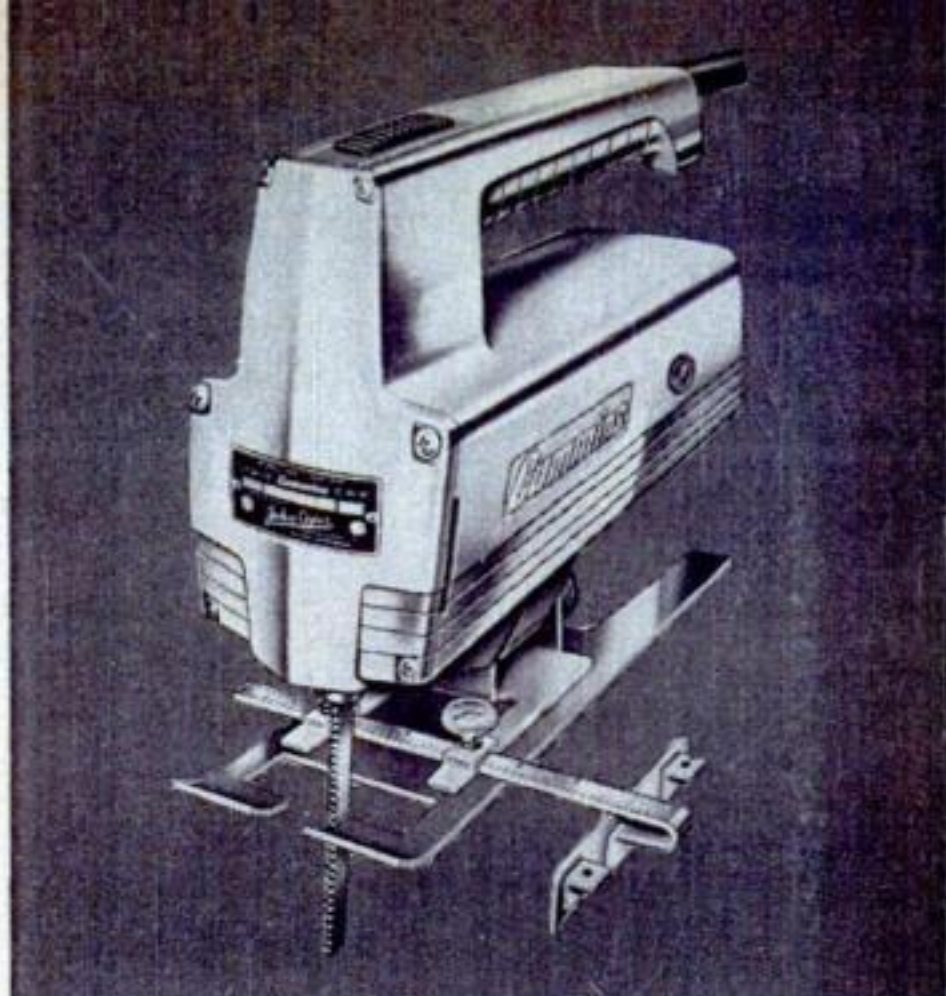
CUMMINS 305-01 DELUXE 1/4" DRILL — A versatile pistol-grip drill that combines quality, performance and price. The perfect partner for any home workshop.

Reg. Price \$29.95
Deluxe metal case . . \$0.88 (A \$5.50 Value)

SPECIAL 3 TOOL DISCOUNT!

Here's a chance to bring your home workshop up to par in a hurry. Buy 3 tools in combination — Sabre-Jig Saw, Drill and Sander — and get an extra discount. Ask your Cummins dealer.

Prices slightly higher in Canada.



new **Cummins**® SABRE-JIG SAW



7
SAWS
IN ONE —
ONLY
\$29.95

Prices slightly higher in Canada.

Dependable, versatile performance at a price to fit any home craftsman's budget! Cummins exclusive, nonstalling automotive cam drive eliminates vibration, provides smooth, even cutting strokes for hairline precision cuts.

Cummins Sabre-Jig Saw combines features of rip, crosscut, band, keyhole, hack, jig and scroll saws ... cuts plywood, plastic, leather or metal. Built-in chip blower keeps cutting line clear.



Calibrated bevel quadrant for accurate angle cuts to 45° right or left.



Convenient heel rest protects blade when saw is not in use, simplifies blade change.



Starts its own hole for clean, fast pocket or keyhole cuts—no pre-drilling.

Cummins Sabre-Jig Saw Blades — A Blade for Every Job!

7-TOOTH BLADE — for general rough cutting in all lumber to 2" dressed, rip, bevel or crosscut.

No. 24144.....3 for \$1.25

10-TOOTH BLADE — produces medium-finish cut in plywood, all lumber up to 1". Allows short radius turns.

No. 24145.....3 for \$1.25

18-TOOTH BLADE — for cutting sheet metal, mild steel to 1/16" thin wall tubing, BX cable, non-ferrous metals.

No. 24146.....3 for \$1.25

10-TOOTH HOLLOW GROUND BLADE — for extra-fine finish cuts in all woods, especially plywoods and laminates. No. 54317.....\$0.85

7-TOOTH FLUSH CUTTING BLADE — cuts right up to vertical surfaces, for installing heat ducts, etc.

No. 54316.....\$1.45

KNIFE BLADE — cuts leather, rubber, corrugated cardboard, chip board, paper, insulating material, acoustical tile. No. 54318.....\$0.45

Only Cummins gives you so many professional features in a low-priced sabre-jig saw!

Cummins[®] MAXAW[®]

"a cut above" all other saws!

EXCLUSIVE PROFESSIONAL FEATURES!

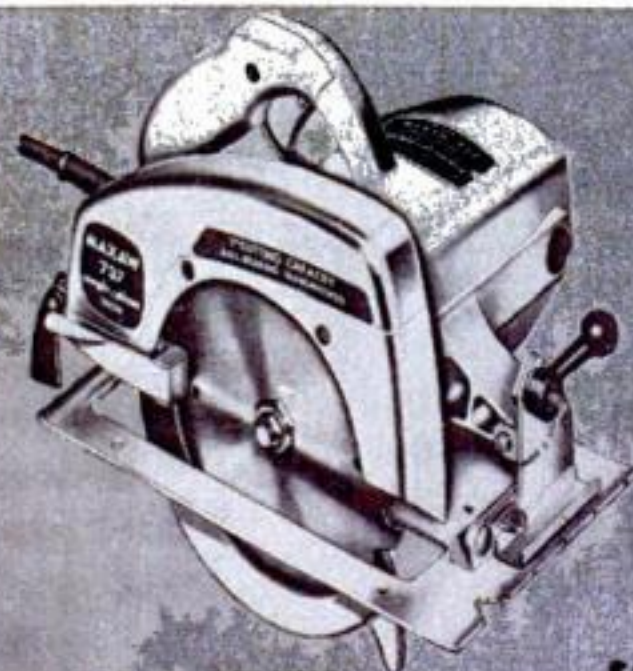
Only Cummins MAXAW offers you *magic-pivot* for deeper angle cuts with blade to spare... *True-Course Guide* to keep blade on line, keep cut open... *Pedestal Base* for easier blade changing... *Telescoping Safety-Guard* shields blade... *Blade Clutch* eliminates kick-back, prevents blade and motor damage... many more features! Real professional quality and performance for home craftsmen, professionals. Full size cutting capacity to make every cut required in building everything from bookcases to complete houses!

Prices slightly higher in Canada.



MAXAW 727-01 \$54.95

7" cutting capacity precision-built to quality standards of long life and performance, yet priced attractively low! Cuts 2" dressed lumber at 45° angle.



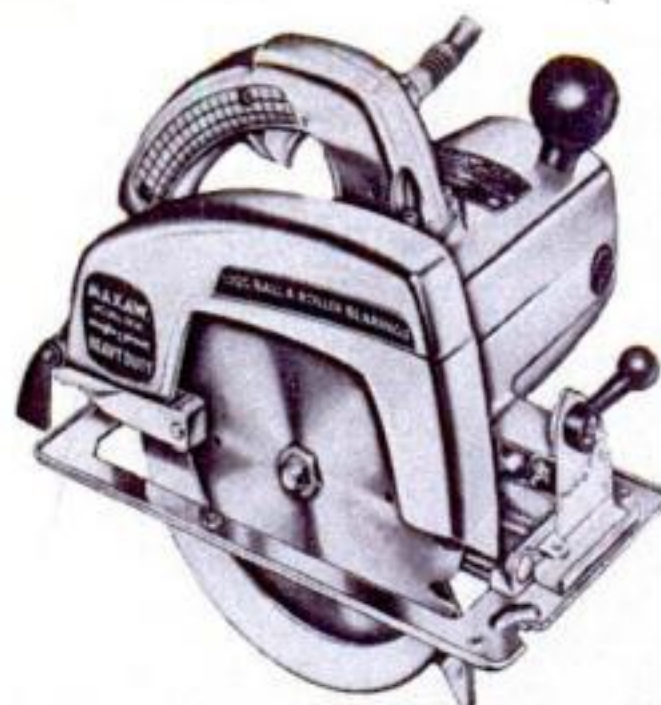
MAXAW 737-01 DELUXE \$62.95

7" cutting capacity king-size cutting performance, partial ball bearing construction, powerful motor. Best buy for home craftsman who demands highest quality. Cuts 1 7/8" at 45°; 2 1/8" at 90°.



MAXAW 757-01 CUSTOM BUILDER'S \$69.95

7" cutting capacity 100% ball and roller bearing construction! A builder's saw that handles the toughest cutting jobs for industrial use. Cuts 1 7/8" at 45°; 2 1/8" at 90°.



MAXAW 7800-01 BUILDER'S \$89.95

8" cutting capacity. A builder's saw that is built for brute strength, with 100% ball and roller bearing construction. For jobs that need maximum power, cutting capacity, continuous-duty use. Cuts 2 1/8" at 45°; 2 1/2" at 90°.



Look for this sign of Cummins "PAY-OFF POWER" at these key dealers!

CALIFORNIA

Antioch, Howse Hardware Company
 Arcadia, Henry's Hardware
 Arcata, Hensel Hardware
 Atwater, Passadori Hardware
 Auburn, Alpha Hardware Company
 Diamond National Corp.
 Azusa, Victor's Paint
 Barstow, Cecils Paint and Hdwe.
 Bellflower, Bell Hardware
 National Lumber
 Belmont, Belmont Hardware
 Big Bear Lake, Craven Building
 Material
 Ceres, Ceres Hardware
 Chico, Diamond National Corp.
 Chowchilla, Perry Hardware
 Claremont, Claremont Lumber Co.
 Clovis, Deavers Hardware
 Coalinga, Coalinga Hardware Co.
 Hoover Lumber Co.
 Concord, Diamond National Corp.
 Cotati, Diamond National Corp.
 Crockett, Pedrotti Hardware Co.
 Culver City, Builders Square Lumber
 Co.
 Denair, Denair's Hardware Co.
 Dos Palos, W. M. Mumby Hardware
 Downey, Downey Lumber
 E. R. Stanfield
 El Cajon, Glenview Supply
 El Monte, Crawfords Modern Village
 Stores, Inc.
 El Sobrante, Olivers Hardware
 Escalon, Strand Bros. Hardware
 Esparto, Diamond National Corp.
 Eureka, Shafer Hardware
 Fairfield, Diamond National Corp.
 Evans and Pyle
 Fair Oaks, Diamond National Corp.
 Farmersville, Lane's Hardware
 Firebaugh, Firebaugh Appliance and
 Hdwe.
 Fremont, Dale Hardware Co.
 Fresno, Easton Lumber and Supply
 Rhodes Department Store
 Village Home & Hdwe. Center
 Yosemite Lumber Co.
 Fullerton, Rogers & Vaughn Hardware
 Galt, Diamond National Corp.
 Gilroy, Chappell Hardware Co.
 Glendale, City Home & Garden
 Supply
 Grass Valley, Alpha Hardware Co.
 Diamond National Corp.
 Guerneville, Guerneville Hardware
 Gustine, Azevedo Hdwe. & Implement
 Hollister, Brown and Chappell Hdwe.
 Hughson, Hughson Hardware
 Huron, Huron Lumber & Supply Co.
 Imperial Beach, Baker Hardware
 Ivanhoe, Ivanhoe Hardware
 Kerman, Kerman Hardware
 Lake Arrowhead, Ganahl Lumber Co.
 La Mesa, Resner Hardware
 Livermore, Diamond National Corp.
 Livingston, Ecclefields Hardware
 Lodi, Diamond National Corp.
 Los Angeles, Andys Hardware
 Atlas Paint and Hdwe.
 Bob's Surplus
 Broadway Hardware
 Madera, Madera Lumber & Hdwe.
 Malibu, A & B Plumbing and Electric

Manteca, Diamond National Corp.
 Hardware Mart
 Martinez, L. M. Lasell Co.
 Mendota, Westside Hardware
 Merced, Merced Hardware Co.
 Parkers Hardware
 Parrceis Hardware
 Modesto, Diamond National Corp.
 Stanislaus Implement & Hdwe. Co.
 Monterey Park, Garvey Hardware
 Moorpark, Moorpark Milling & Hdwe.
 Morgan Hill, Squeri Bros. Hardware
 Mt. View, Hubbard & Johnson
 Lumber Co.
 Nevada City, Alpha Hardware Co.
 Norco, Taylor's Builders Mart
 Oakland, Ellis Hardware Co.
 Orland, Diamond National Corp.
 Oreville, Diamond National Corp.
 Pacific Grove, Holman's Dept. Store
 Pacific Palisades, Pacific Palisades
 Lumber & Material
 Palmdale, Forest Lumber Co.
 Paradise, Paradise Hardware
 Diamond National Corp.
 Parlier, Parlier Lumber Co.
 Patterson, Patterson Hardware
 Perris, Community Lumber Co.
 Reynolds Hardware
 Petaluma, Rex Hardware Company
 Placerville, Fisher Hardware Co.
 Pomona, Wiloma Custom Built Screen
 & Power Tool Distributor
 Porterville, Jones Hardware
 Red Bluff, Diamond National Corp.
 Lyon-Garrett Co.
 Redding, The Diamond National Corp.
 Redlands, Dickinson Hardware
 Redwood City, Imperiale Hardware
 Co.
 Ripon, Schemper Hardware
 Riverdale, Brown Hardware
 Riverside, Better Homes Industries
 Rodeo, Curley's and Son Hardware
 Sacramento, Diamond National Corp.
 George Sales Co.
 Shorrock's Hardware
 St. Helena, Central Valley Builders
 Supply
 San Bernardino, Tom Fergen Hardware
 San Bruno, Rhoads Hardware Co.
 San Diego, Resner Hardware
 Whitney's Dept. Store
 San Francisco, Brentwood Hardware
 Center Hardware Co.
 Howse Hardware Co.
 G. B. Jackson & Son, Inc.
 L. R. Jackson Homewares
 Lakeside Hardware and Lumber
 Levin's Auto Supply
 MacKillop Hardware Co.
 Ocean View Hardware
 Portola Hardware and Appliance
 Sanger, Wagner Hardware
 San Jose, Farmers Union Hardware
 Thoeny Bros. Hardware
 San Leandro, Line Hardware Co.
 San Lorenzo, Manor Hardware
 Santa Monica, Bourgett Brothers
 Stockton, Diamond National Corp.
 Dunlap Hardware
 Sunnyvale, Cherry Chase Hardware
 Temple City, Western Auto
 Tranquillity, Hansen Bldg. Materials
 & Supplies

Turlock, Turlock Hardware
 Ukiah, Portlock Hardware Co.
 Upland, Upland Lumber Co.
 Upland Self Service Center
 Vacaville, Diamond National Corp.
 Pacific Hardware Co.
 Vallejo, Walker's Supply Co.
 Ventura, Zepco Products
 Whittier, Kietas Town & Country
 Hdwe.
 Russell Lumber Co.
 Willows, T. W. Ward Hardware
 Wilmington, Wilmington Hardware
 Woodlake, Woodlake Hardware Co.
 Woodland, Cranston Brothers
 Yucca Valley, Yucca Valley Lumber
 Co.

COLORADO

Arvada, J. W. Metz Lumber Co.
 Ray's Hardware Store
 Aurora, Aurora Hardware & Paint Co.
 Boulder, Hogsett Lumber Co.
 Johansen's Hardware
 Brighton, United Lumber and
 Hardware, Inc.
 Cedaredge, Cedaredge Lumber Co.
 Denver, L. D. Chase Lumber Co.
 Hart's Corner Hardware Store
 Jensen Hardware Co.
 Derby, Derby Lumber and Supply Co.
 Ft. Lupton, Vincent's Hardware and
 Implement
 Lakewood, Linke's Hardware
 J. W. Metz Lumber Company
 Longmont, Home Lumber Co.
 Louisville, Steinbaugh Lumber &
 Hardware Co.
 Wheatridge, Wheatridge Lumber Co.

CONNECTICUT

Ansonia, Alexander's Hardware
 Brandford, Radio Surplus Store
 Bridgeport, Central Hardware
 Granfield Hardware
 Schweizer Hardware
 Tip Top Hardware
 Tunix Hill Hardware
 Yurdin Hardware
 Bristol, Maple End Hardware
 Scarritt Lumber Co.
 Colchester, Einhorn Grain
 Durham, Coe and Eick
 Fairfield, Fairfield Lumber Co.
 Hartmann Hardware
 Kele Hardware
 Poster Hardware
 Stratfield Hardware
 Tunix Hill Hardware
 Glastonbury, Glastonbury Paint and
 Wallpaper
 Greenwich, Scalzi-Wooton Paint &
 Lumber
 Hamden, Centerville Lumber
 Hartford, Guthart, Inc.
 Huntington, Huntington Paint &
 Hardware
 Milford, Builders Supply Co. of Mil-
 ford
 Naugatuck, Western Auto
 New Haven, Gurland Hardware
 New Haven Hardware
 Robin Paint & Hardware
 Russo Brothers Paint
 North Haven, Drazen Lumber Co.
 Plainville, Plainville Hardware
 Ridgefield, The D. F. Bedient Co.



Seymour, Housatonic Lumber
 Southington, Neal Hardware
 Stratford, Windt's Hardware
 Thompsonville, Western Auto
 Trumbull, Tickey's Hardware
 Waterbury, Mahler's
 Valley Hardware
 Watertown, Western Auto
 Woodbridge, Woodbridge Lumber

DELAWARE

Dover, Bob and Bill's Hardware
 Wilmington, Suburban Hardware
 H. H. Ulmer Hardware Co.
 Wilmington Hardware Co.

FLORIDA

Bradenton, Builders Supply Co.
 Manatee County Lumber Co.
 Shamps Craft Shop
 Clearwater, Davis Supply Co.
 Coral Gables, Renuart's Lumber Yards
 Fort Lauderdale, Amar Hardware Co.
 Gate City Lumber Co.
 Tools Inc.
 Gainesville, Hughes Supply Co.
 Stringfellow Supply Co.
 Hollywood, Mack Industries
 Inverness, Ray's Hardware & Building
 Supply Co.
 Jacksonville, Graves, Inc.
 Jupiter, Lainhart & Potter Lumber Co.
 Live Oak, Langford Builders Supply
 Co.
 Miami, Alexander Hdwe. & Bldrs.
 Supply Co.
 Bernard Industries
 Farreys Hardware Co.
 Lafayette Tool & Supply Co.
 Rowell Distributing Corp.
 Smitty's Hardware & Paint
 Miami Springs, Fitzpatrick Sales
 Mount Dora, J. D. Pease & Son
 New Port Richey, Davis Supply Co.
 North Fort Myers, Al's Super Market
 Panama City, Remsco Inc.
 Seaco Electrical Supply Co.
 Pasadena, Davis Supply Co.
 Pensacola, Cesco Inc.
 Hundley Distributing Co.
 Plant City, Plant City Auto Supply Co.
 Port Charlotte, Mac's Hardware Co.
 Sarasota, Graves, Inc.
 Davis Lumber Co.
 Tampa, London Hardware Co.
 Poston Marine Supply Co.
 Vick's Swap Shop
 Wilkins Hardware
 West Miami, South and West Miami
 Key Shop
 West Palm Beach, Lainhart and
 Potter Lumber Co.
 Power Tool Sales and Service Co.
 Rowell Distributing Corp.

IDAHO

Grangeville, Madison Lumber & Hard-
 ware
 Lewiston, Lewiston Clarkston Lumber
 Co.
 Moscow, Standard Lumber Co.
 St. Maries, Economy Hardware
 Sandpoint, Bargain Supplies Co.
 Littlefield's

ILLINOIS

Bloomington, West Side Coal & Lbr.
 Co.
 DeKalb, Gordon Hardware & Supply
 Freeport, Sanford & Zartman Lbr. Co.

Kankakee, H. H. Troup & Co.
 Peoria, Hobby Models
 IOWA

Clinton, Nelson's Cashway Lumber
 Co.

Hawarden, Swanson Hardware
 LeMars, Sieverding-Walz Co.
 Spencer, C. Ben Bjornstad Hardware
 Waterloo, R. E. Morris Hardware
 Plumbing and Heating Co.

MAINE

Berwick, John A. Bell
 Dixfield, Towles Hardware
 Mechanic Falls, E. A. Parker and
 Son, Inc.
 Sanford, Colby and Woodman
 Wells, A. M. Morse and Sons

MASSACHUSETTS

Abington, Robertson Lumber Co.
 Amesbury, Amesbury Hardware Co.
 Ashland, Ashland Hardware Co.
 Athol, Zack Sales
 Billerica, Cushmans Hardware
 Bridgewater, J. H. Fairbanks Co.
 Chelmsford, Harvey Bldg. and Wreck-
 ing
 Danvers, Line Lumber Co.
 Dennisport, Robert Henderson
 Supply Co.
 East Bridgewater, Dewhurst Lumber
 Co.
 Fairhaven, C. F. Delano, Inc.
 Framingham, Monnick Supply Co.
 Red's Supply
 Harwich, D. T. Bates Co.
 Holbrook, Hardware Centre
 Hyannis, Central Hardware
 Ipswich, Wirthmore Store
 Leonminster, Airport Sales and
 Supply
 Marlboro, Lincoln Hardware Co.
 North Easton, Wm. Ladd Hardware
 North Plymouth, Kingston Lumber Co.
 Provincetown, Lands End Marine
 Supply
 Reading, Wagner Bros. Co., Inc.
 Roslindale, Doherty Lumber Co.
 Sandwich, Sandwich Hardware
 Shrewsbury, Spags Supply
 So. Dennis, Leon W. Hall, Inc.
 So. Hamilton, Chittick's Farm Supply
 So. Yarmouth, So. Yarmouth
 Hardware
 Stoughton, Colonial Hardware
 Tewksbury, Tewksbury Speed and
 Sport Co.
 Westfield, Home and Garden Shop
 Waltham, Wal-Ex Hardware Co.
 Wareham, Edwin L. Morse Co.
 West Newton, A. J. Harris Hardware
 Willimansett, Aubuchon Paint &
 Hardware
 Worcester, Alan Barry Corp.

MICHIGAN

Ashley, Ashley Hardware
 Athens, E. W. Merchant Hardware
 Battle Creek, Snyders Hardware
 Belding, Belding Hardware
 Carson City, Barnes Hardware
 Charlotte, Charlotte Hardware
 Chesaning, Gewritz Hardware and
 Appliance
 Decatur, Slack's Hardware
 Detroit, Eastown Paint and Hardware
 Federal Merchandise Mart
 Fenkel Hardware
 F. M. Sibley Lumber Co.
 Warwick Hardware
 Elsie, Darling's Appliance
 Farmington, Dickerson Hardware Co.
 Frankfort, Deo Courville Lumber
 Grand Haven, Cook Hardware and
 Plumbing

Grand Rapids, Andringa's Hardware
 and Appliance
 Godwin Hardware
 Stryker Hardware
 Thompson Hardware

Hudsonville, Gemmens Hardware
 Ionia, Stones Firestone Store
 Ithaca, Larry's Hardware
 Jackson, Barber's Hardware and Bike
 Shop

Kalamazoo, Goggin Company
 Miller Lumber Company
 Lake City, Van's Building Supply
 Lincoln Park, F. M. Sibley Lumber
 Company

Livonia, F. M. Sibley Lumber Co.
 Manistee, Wahr Hardware
 Manton, Manton Hardware
 Marshall, Mitchell Hardware
 Middleville, Norman Hardware
 Muir, Muir Hardware
 Orchard Lake, Walls Hardware
 Owosso, Pabst Bros. Hardware
 Oxford, Tunstead Hardware
 Pontiac, Tom's Hardware
 Portage, Portage Lumber Co.
 Rochester, Burr Hardware
 St. Clair Shores, F. M. Sibley Lumber
 Company

Superior Feed and Supply
 St. Johns, Alan R. Dean Hardware
 Scottville, Wissner's General Store
 So. Lyon, Gates Hardware
 Stanton, Bernie's Hardware
 Warren, Leonard's Hardware
 Weidman, Fox Hardware
 White Cloud, A. Q. Adams Hardware
 Ypsilanti, Martin-Dawson Company

MINNESOTA

Alexandria, Alex Farm and Home
 Bagley, Bagley Mercantile Company
 Bemidji, Swedmark Hardware
 Bigfork, Bunnell's Hardware
 Blackduck, Nendick Hardware
 Blooming Prairie, Ille Hardware
 Brewster, Brewster Hardware
 Chisholm, Centa Hardware
 Crystal, The Building Block, Inc.
 Ely, Lynn Hardware and Furniture Co.
 Gibbon, O. N. Johnson Co.
 Grand Rapids, Mills Lumber Company
 Grey Eagle, Peschel Hardware
 Hawley, Quirt Hardware
 Holdingford, Pogorelc Hardware
 Janesville, Vinson Hardware
 Kasson, Beaver Hardware
 Lake Benton, Marti Hardware
 Le Sueur, O'Brien Hardware
 Minneapolis, Camden Hardware
 Hardware Hank Store
 Minnesota Lake, Bach Hardware
 Morgan, Morgan Hardware
 Nashwauk, Nashwauk Hardware
 Osakis, Mouw Hardware
 Procter, C. W. Austin Hardware
 Redwood Falls, Paffrath-Voelz
 Hardware
 Rushford, Jaastad Hardware
 St. Joseph, Loso Hardware
 St. Paul, Hamline Hardware
 Two Harbors, Erickson and
 MacDonald
 Vergas, Vergas Hardware
 Waterville, Jacobson Farm & Home
 Supply
 Watkins, J. M. Ertl and Sons, Inc.
 West Concord, Renner Hardware
 Winona, Bambanek Hardware
 Winthrop, L. J. Larson Co., Inc.

MISSOURI

Florissant, Ozark Paint Stores
 St. Louis, Ozark Paint Stores

MONTANA

Missoula, Wright Lumber Co.

NEVADA

Fallen, Fallon Mercantile

NEW HAMPSHIRE

Concord, C. E. Wilbur Co., Inc.

Lebanon, Lewis Bros., Inc.

Manchester, Clark's Hardware

Meredith, Prescott Lumber Co.

Pittsfield, H. P. Maxfield, Inc.

Raymond, Holt's Hardware

Salem Depot, Salem Hardware and Paint

NEW JERSEY

Asbury Park, Samuel Rubman

Belleville, The Glass Company

Tiber Hardware

Bergenfield, Bergen County Paint

Chartex Paint

Bloomfield, Taton Hardware

Bloomington, Thomas Hoff Hardware

Boonton, Boonton Building Material

Caldwell, H. E. Schanz Co.

Cedar Grove, Bohny Brothers Hardware

Clifton, Able Hardware

Fox Hardware

Friedman's Hardware

New Jersey Lumber and Supply

Dover, Sacks Paint & Wallpaper

East Paterson, Thomas Marino

Hardware

Englewood, Englewood Paint & Hardware

Hudson Hardware

Mitchell Simon Company

Fairlawn, Lincoln Hardware

Plaza Hardware

Florham, Florham Park Hardware

Freehold, J. A. McIlvaine

Frenchtown, George W. Eddy

Garwood, Garwood Paint and Hardware

Glassboro, J. T. Abbott and Son, Inc.

Hackensack, B & S Company

McManus Floor Machine

Palmer Brothers

Romane Hardware Co.

Hackettstown, Hackettstown Hardware

Haledon, Haledon-Belmont Hardware

Haskell, Wanaque Supply Co.

Hillside, Kizyma Paint and Hardware

Jersey City, Miller's Hardware

Kearny, Ratta Hardware

Kenvil, Walt's Hardware

Keyport, Midtown Hardware

Lakewood, Lakewood Lumber Co.

Leonia, Moore's Hardware

Linden, Koenig Hardware

Lodi, Central Hardware

Madison, Otten and Jaegels Hardware

Maplewood, Pletz Brothers

Maywood, Maywood Hardware

Metuchen, Metuchen Builders Supply

Montclair, South End Paint and

Hardware

Montville, Boonton Bldg. Materials

Morristown, Community Lumber Co.

Daher's Hardware

Morristown Hardware

Netcong, Netcong Hardware

Newark, S. La Capra Hardware

New Milford, Housetown Hardware

North Bergen, Fred's Hardware

North Haledon, Ralph Falkena

Nutley, J. Rose, Inc.

Oakhurst, Kays Housewares

Oak Ridge, Boote Supply

Ogdensburg, Chambers Coal and Lumber

Paramus, Davidson Plumbing

Park Ridge, Quackenbush Lumber Co.

Passaic, Steiber Hardware

Paterson, Angelica Hardware

Tirozzi Hardware

Trueman's Hardware

United Hardware

Pequannock, Van Ness Lumber Co.

Pompton Lakes, Smiley's Hardware

Pompton Plains, Jones Hardware

Prospect Park, Verblauw's

Hardware

Radburn, Plaza Hardware

Ramsey, Ramsey Hardware

Riverdale, Pompton Feed and Supply

River Edge, Palmer Brothers

Rivervale, Nugent's Hardware

Roseland, Roseland Hardware

Sayreville, Sayreville Hardware

Sparta, Mac's Hardware

Spotswood, Spotswood Hardware

Union, Jaeger Lumber Company

Villas, Villas Lumber Co.

Vineland, Joffe Hardware Co.

Wallington, 3 Sons Hardware

Wayne, Circle Building Supply

Mountain View Hardware

Westfield, Taylor Hardware

Tudor Hardware Co., Inc.

West Milford, West Milford Hardware

Westwood, E. J. Decker

Wharton, Hopatcong Hardware

Wood-Ridge, Star Auto Stores

NEW YORK

Albany, Rosano Farm Store

Bronx, A & R Sales

Brown's Hardware

Fordham Supply Co.

Parkway Hdwe. & Paint Co.

Van Nest Hardware

Whitestone Paint

Brooklyn, Bay Ridge Saw & Tool

M. S. Berkoff

Brother's Hardware

Gelfand Hardware

Krauser Hardware

R. J. Krieger Paint & Hdwe.

Park Slope Hardware

Paul's Hardware

Petersen Brothers

Square Deal Paint & Hdwe.

Buchanan, Cole Brothers

Cornwall, Clouser Sales

Ushman Brothers

Dobbs Ferry, B. Adler Hardware

Elmsford, Elm Hardware Co.

Florida, Kujawski Brothers Hdwe.

Forest Hills, Yellowstone Hardware

Garnerville, Zugibe Hardware

Hastings-on-Hudson, Main Hardware

Haverstraw, O. N. Rosenberg and Son, Inc.

Shaw Jobson

Hawthorne, Berger Hardware

Hicksville, Botto Brothers Hardware

Hudson, Hudson Lumber Company

Hyde Park, Van Noddall Hardware

Jamaica, F. Boenig and Son

Jeffersonville, W. W. Mall

Larchmont, Foley Hardware

Liberty, Sabloff's

Mahopac, Mahopac Supply

Massapequa Park, S & P Hardware

Middletown, Lloyd's

Monroe, Smith and Streble

New Rochelle, Spitzer Supply

New York, M. Blaustein and Sons

Booky Hardware

G & E Hardware

Garber Hardware

Goldsmith Brothers

Grand Central Hardware

Frank Hoffman



Kraus Hardware

Lohmann Hardware

Lucerne Hardware

New Hippodrome Hardware

Quality Hardware Company

S & S Hardware

Safeway Maintenance

Sol's Key Shop

Suburban Supply

Wadsworth Hardware

North Tarrytown, C. Margotta Co.

Ozone Park, Shop-Rite Hardware

Patchogue, Grover Lumber Co.

Port Chester, Feinsod Hardware

Poughkeepsie, Malone Hardware

Red Hook, C. J. Stockenberg

Rhinebeck, Cookingham Hardware

Rye, Odell's Hardware

Shrub Oak, Lakeland Lumber

Sloatsburg, Sloatsburg Hardware

So. Glens Falls, Clydes Hardware and Appliance Co.

So. Ozone Park, Sonny's Hardware

Spring Valley, K & A Hardware

Stoney Point, Homestead Hardware

Suffern, Home Appliance Service

Thornwood, Klingler Hardware Co., Inc.

Tuckahoe, Cornell's

Wappingers Falls, Urey Hardware

Warwick, Miller and Stocken Lumber Co.

Watervliet, De Lollo Hardware

Westbury, McNeil Hardware Co.

West Nyack, West Nyack Country Store

White Plains, House Center Hardware Pickard Hardware

Woodridge, Sunray Paint and Hardware

Wurtsboro, Graubard and Mann, Inc.

Yonkers, Grassy Sprain Hardware

Musci Hardware

J. C. Ryan

Schall Paint and Hardware Co.

Service Center

Town and Country Lumber

Wrocklage Hardware

Long Island, New York

Baldwin, Fairview Hardware Co.

Josh Wolin Hardware

Carle Place, Carle Place Hardware

Deer Park, A & J Howe

East Meadow, Ace Store of East Meadow

Allan Lumber

Elmont, Tudor Hardware

Hicksville, New Bridge Lumber

Huntington, Central Hardware

Save-On Hardware

Huntington Station, He-Lo Supply, Inc.

Jamaica, Springfield Paint & Hardware

Middle Island, Ben's Auto and Hardware

Middle Village, Zwibel Hardware

New Hyde Park, Barlow Hardware

Northport, Northport Hardware

Oceanside, Oceanside Hardware

Port Washington, Manorhaven Hardware

Seaford, 3 Generations Hardware

Uniondale, Irwin Lumber Co.

Valley Stream, Wood's Hardware

Westbury, Ellisons Hardware



West Islip, Higbie Garden Center
Williston, A & T Hardware Co.
Woodmere, B & B Hardware

Staten Island, New York
Staten Island, Geisinger Hardware
Port Richmond, Mal's Hardware
Stapleton, H. S. Farrell
Westerleigh, Gelgisser Hardware

NORTH CAROLINA

Clinton, Varina Builders Supply
Farmville, Varina Builders Supply
Fuquay Springs, Varina Builders Supply
Greensboro, Varina Builders Supply
Raleigh, Varina Builders Supply
Rockingham, Varina Builders Supply
Varina, Varina Builders Supply

NORTH DAKOTA

Bowman, Stubers Farm and Ranch
Jamestown, Hall Hardware
Lisbon, Bohlen Hardware and Furniture
Wahpeton, Bohlen Hardware and Furniture

OHIO

Cincinnati, John Shillito Co.
Widmer Electric

OREGON

Astoria, Western Auto Stores
Beaverton, Falk's Hardware
Canby, Stefani Lumber Co.
Coos Bay, W. J. Conrad Lumber Co.
Coquille, W. J. Conrad Lumber Co.
Cresswell, Cresswell Electric
Dallas, Western Auto Supply
Eugene, Hirshey Appliance Plants, Inc.
Gladstone, Clackamas County Grange Supply
Hood River, Franz Hardware
Myrtle Point, Moon Hardware
Newport, Western Auto Stores
Oregon-Willamette Lumber Co.
Newberg, Western Auto Stores
North Bend, Coos Head Builders Supply
Oregon City, Friedrich's Hardware
Pendleton, Zimmerman Hardware
Pilot Rock, Pilot Rock Hardware
Portland, Beaumont Hardware
Burdick's Hardware
Cedar Mill Lumber and Hardware
Copeland Lumber Company
Francis Bros. Bldg. Mart
G. I. Joe's Supply
Hal's Building Supply
La Forge's Hardware
Meier and Frank Dept. Store
Oregon-Willamette Lumber Co.
Power Tool Center
Wink's Hardware
St. Helens, Heinie's Feed Store
Salem, Busick's Lancaster Market
Meier and Frank Dept. Store
Valley Farm Hardware
Scappoose, Langdon Supply Co.
Sheridan, Western Auto Stores
Stayton, Western Auto Supply
Sutherlin, Sutherlin Hdwe. and Bldg. Supply
Tillamook, Buel Hardware
Woodburn, Livesays Lumber Yard
Yoncalla, Delbert Dickey Auto Parts

PENNSYLVANIA

Altoona, Morrow Hardware
Wolf Furn.
Ambler, G. M. Deck and Co.
Bethlehem, Fink Supply Co.
Butler, Smith Hardware
Camp Hill, Moore's Builders Supply
Chambersburg, Appalachian Lumber Corporation
Chester, Stress Brothers
Churchville, Churchville Hardware
Erie, Liberty Hardware
Easton, Suburban Hardware
Essington, Yaskin's Hardware
Feasterville, Feasterville Hardware
Fernwood, Master Hardware Co.
Gettysburg, George M. Zerfing
Harrisburg, Albright's Hardware
Moore's Builders Supply
Hellertown, Miller Bros. Hardware
Huntingdon, Lloyd's Hardware
Lancaster, Farmers Supply Co.
Littletown, George M. Zerfing Hardware
Mars, Weaver Hardware
Milesburg, Valley Building Supply
Monessen, Rem's Electric
New Holland, Groff's Hardware
Norristown, Eskin Hardware Co.
Philadelphia, Frankford Hardware Co.
H. R. Hidell
Kane and Brown
Penn Hardware Co.
Strawbridge and Clothier
Pottstown, Van Buskirk and Brothers
Reading, J. W. Leinbach Hardware Co.
Winters Hardware Co.
Willow Grove, Eskin Hardware Co.

SOUTH CAROLINA

Orangeburg, Varina Builders Supply
Timmons ville, Varina Builders Supply

SOUTH DAKOTA

Deadwood, Stearns and Shedd
Dell Rapids, Kranz Hardware
Pierre, Spargur Hardware
Rapid City, Pavak's West Side Hardware

TEXAS

Arlington, Bowman-Cass Lumber Co.
Bedford, Walter Fitch Hardware Co.
Blooming Grove, W. E. Carrol Hardware
Bridgeport, Jones Hardware Co.
Chico, Brooks Motor and Hardware
Cleburne, John Street Hardware Co.
Crosbyton, Brashear's
Dallas, Barn's Lumber Co.
Glendale Hardware Co.
Kessel's Hardware Co.
Walnut Hill Hardware Co.
Wiseman Hardware
Denton, B & H Lumber Co.
David Mulkey Hardware Co.
Denver City, Stanley Auto Supply
Ennis, Ross Crumley Hardware
Fort Worth, Buddies Feed and Farm Store
Everybody's
Forest Hill Hardware Co.
O. B. Gynn Hardware
Massie Supply Co.
Ridglea Hardware Co.
Schmid Hardware
Grand Prairie, Grand Prairie Hardware Co.
Hamilton, Wilson Hardware & Electric Service
Hurst, S & S Hardware Co.
Idalou, Blue Flame Gas Co. Hdwe. & Appliance

Itasca, McPherson Hardware
Justin, Justin Lumber Co.
Killeen, Killeen Hardware Co.
Knox City, City Hardware Co.
Littlefield, Nelson Hardware Co.
Mansfield, Wynn's Hardware Co.
Meridian, Meridian Hardware Co.
Mexico, Tyner-Lekey
Morton, Higginbotham-Bartlett Lumber Co.
Muenster, Community Lumber Co.
Plainview, Plainview Hardware Co.
San Antonio, Joskes
Scurry, Gates Lumber Co.
Temple, Temple Hdwe. Co.
Terrell, Crain's Home & Auto Supply
The Grove, The Grove Lumber Co.
Weatherford, Glenn Sanders Hdwe. & Auto Supply

UTAH

Salt Lake City, City Electric Supply Co.

VIRGINIA

Newport News, Moore's Builders Supply
Norfolk, Moore's Builders Supply
Petersburg, Moore's Builders Supply
Richmond, Moore's Builders Supply
Verona, Moore's Builders Supply

WASHINGTON

Aberdeen, Lumber Supplies, Inc.
Camas, H. R. Ward Co.
Centralia, Graystone of Centralia Midway Building Supply
Chehalis, Lewis Pacific Dairyman's Association
Connell, Connell Builders Supply
Kalama, Baker Lumber Company
Kelso, Baker Lumber Co.
Kennewick, Diamond National Corp.
Long Beach, Dennis Company
Longview, International Paper Co.
Long-Bell Retail Division
Moses Lake, Express Lumber Co.
Newport, Diamond National Lumber Co.
Geaudreau Lumber Co.
Opportunity, Madison Lumber & Mill Co.
Othello, Broadway Lumber & Mill
Pullman, Standard Lumber Co.
Raymond, Dennis Co.
Spokane, Country Homes Supply
Diamond National Lumber Co.
Hoesly's Hardware
Kehoe Hardware
Lincoln Heights Bldg. Supply
Marshall's Northtown Hdwe.
North Hill Hardware
Northwest Hardware
Stewart's Home Town Hdwe.
Stevenson, Columbia Loggers Supply
Trentwood, Leader Lumber & Hardware
Vancouver, Independent Lumber Co.
White Salmon, Chuck's Hardware
Woodland, Copeland Lumber Company

WEST VIRGINIA

Fairmont, Marion Supply
Grafton, Builders Service & Supply
Morgantown, Wesco

WISCONSIN

Adell, Huibregtse Hardware
Appleton, Do It Yourself Shops
W. T. Grant Co.
Belleville, Koltes & Keegan
Eau Claire, Consumers Co-op Association
Ellsworth, Hovde Hardware

Green Bay, Van's Supply & Equipment Co.
 Lodi, Koltes Lumber Co.
 Madison, Findorff Lumber Co.
 Koltes & Esser Hdwe.
 Mazomanie, Koltes Hardware
 Menomonee Falls, Neu Supply Line
 Middleton, Fish Building Supply
 Koltes & Keegan
 Milwaukee, American Plumbing Stores
 Buettow Hardware Co.
 Schuster's
 Steinman Lumber Co.
 Weissman Hardware
 Wisconsin Rock Wool Co., Inc.
 W. T. Grant Co. (Southgate)
 Oostburg, Daane Hardware
 Park Falls, John Peterson Lumber Co.
 Prairie du Sac, Koltes & Kennedy
 Racine, Norm's Builders Hdwe.
 St. Croix Falls, Clayton Hardware
 Sheboygan, Braun and Herr
 South Milwaukee, Modern Bilt Lumber Co.
 Stoughton, Koltes & Keegan Stores
 Sun Prairie, Koltes & Moldrem
 Superior, East End Hardware
 Waterloo, Zibell Hardware Co.
 Waunakee, Koltes Lumber Co.
 West Bend, W. K. Smith Hardware

HAWAII

Hilo, Hilo Farmers Exchange, Ltd.
 Sakai Painting & Supply
 The Trader
 Honolulu, Uptown Hardware

KAUAI, HAWAII

Lihue, Harry's Appliances
 Kapaa, Kawamoto's

KAUNAKAKAI, HAWAII

Molokai, Molokai Building Supply

MAUI, HAWAII

Wailuku, Valley Hardware Store
 Maui Dry Goods & Grocery Co., Ltd.

OAHU, HAWAII

Kaneohe, Uptown Hardware Store
 Waipahu, Kiso Store

CANADA

ALBERTA

Alliance, McLennan Hardware
 Athabasca, A. O. Evans
 Bowness, Bowness Hardware
 Calgary, Orville Burke Lumber
 G. L. Chesney Hardware
 Findlay Hardware
 Muttart Building Supplies
 Nagler's Limited
 Ribtor Surplus Sales
 Carstairs, Trottier Brothers
 Didsbury, Leeson Hardware
 Eckville, Eckville Co-op
 Edmonton, Imperial Lumber Co.
 Jamieson Hardware
 J. C. McLeod Building Supplies
 M. D. Muttart Limited
 Northern Hardware Co., Ltd.
 Woodwards Stores, Ltd.
 Innisfail, Burrows Hardware
 Lethbridge, North Lethbridge Hardware
 Medicine Hat, Sept. & Sons
 Red Deer, Mitten & Sherbino
 Rocky Mountain House, Killico Stores
 Spruce Grove, McLeod Mercantile Co.
 Vegreville, Northern Hardware Co.
 Vermilion, Northern Hardware Co.

BRITISH COLUMBIA

Campbell River, Central Builders Supplies

Chilliwack, P & E Builders Supplies Ltd.
 Coquitlam, Van's Building Supplies, Ltd.
 Duncan, Garner Builders Supplies, Ltd.
 Esquimalt, Stelck's Esquimalt Hardware
 Haney, Fuller-Watson, Ltd.
 Kamloops, N. S. Dalglish, Ltd.
 Kelowna, Wm. Haug & Son, Ltd.
 Kitimat, Kitimat Builders Supplies
 Nanaimo, Stewart & Hudson, Ltd.
 New Westminster, Ridgeway Hdwe. & Bldg. Supplies
 Sarginson & Dumond Ltd.
 Woodward Dept. Stores, Ltd.
 North Vancouver, Seaford Sales, Ltd.
 Port Alberni, A. McDonald and Sons
 Prince George, Blairs Outfitting, Ltd.
 Prince Rupert, Philpott-Evitt Co., Ltd.
 Richmond, Lansdowne Hardware
 Trail, D. B. Merry Lumber Co.
 Vancouver, B & B Hardware, Ltd.
 Collingwood Hardware Co.
 Crystals, Ltd.
 Harvey's Stores, Ltd.
 Woodward Dept. Stores, Ltd.
 Vernon, Wilcox-Hall Co., Ltd.
 Victoria, Shawnigan Lumber Yards, Ltd.

Stelck's Hillside Hardware
 Steward and Hudson, Ltd.
 West Vancouver, Hodgson Clarke Stores, Ltd.
 West Vancouver Hardware & Home Appliance
 Woodward Stores
 Whalley, Arrow Building Supplies

ONTARIO

Agincourt, Matthews Hardware, Ltd.
 Almonte, N. S. Lee & Sons
 Aylmer, Monteith Hardware
 Belleville, E. D. Mott & Sons, Ltd.
 Arthur A. Sills & Son, Ltd.
 Blind River, F. Y. W. Braithwaite
 Bowmanville, McGregor Hardware, Ltd.
 Bradford, Gardner Hardware
 Brantford, Elliott-Wedlake, Ltd.
 Brockville, Stewart Hardware
 Burford, Baisdon Hardware
 Burlington, Dales Hardware
 Lindley Bros., Ltd.
 Chatham, Douglas Hardware
 Richmond Hardware
 Clinton, Hall & Mutch I.H.A. Hardware
 Cobourg, Roy Caine Lumber Co.
 Cornwall, Snetsinger I.H.A. Hardware
 Delhi, Smith Hardware and Heating
 Eastview, Landriault I.H.A. Hardware
 Elliot Lake, Super Shops I.H.A. Hardware
 Forest, Lochead Hardware
 Frankford, Frankford Hardware
 Gananogue, Donevan Hardware
 Highland Creek, Lomas Hardware
 Lakeview, Briscoe Hardware
 Listowel, Hay I.H.A. Hardware
 Lorne Park, Bolton-Ellis-Weaver
 Merriton, McNeil I.H.A. Hardware
 Norwich, Maybee I.H.A. Hardware
 Oshawa, Swan Hardware
 Ottawa, Desjardin's I.H.A. Hardware
 Vandervoort I.H.A. Hardware
 Pembroke, Phillips Hardware
 Penetanguishere, McDonald Hardware
 Perth, Chaplin & Code
 Port Credit, Ryerson Hardware



Port Perry, Peel Hardware
 Renfrew, McPhail Hardware
 Richmond Hill, Richmond Hardware
 Rockwood, Root Hardware
 St. Catharines, McNeil Hardware
 St. George, Longs Hardware
 Sault Ste. Marie, Hill Hardware
 Simcoe, Prellip-Schott Hardware
 Smith's Falls, Clark & Lewis
 Tilbury, T. F. Van Aman & Sons
 Tillsonburg, Maybee I.H.A. Hardware
 Toronto, Glen Agar Hardware
 Austin Hardware & Sports
 Len Barraca Sales, Ltd.
 Hudson Hardware
 Potter Hardware
 G. Travis I.H.A. Hardware
 Trenton, Allore Company, Ltd.
 Bailey Hardware
 Weston, Bannerman Hardware
 Riggs Rexdale Hardware
 Windsor, Bird Hardware
 Wingham, Stainton Hardware
 Woodstock, Dennis Hardware

QUEBEC

Boucherville, Marcel Turcotte
 Buckingham, De Societe Coop de Buckingham
 Croydon, John Ryan, Ltd.
 East Broughton, Laiterie Co-operative Agricole
 Felicien, Ferr St. Felicien
 Gatineau, De Jean Racine
 Grand-Mere, Ferr Grand-Mere Enrg.
 Hull, Lafrance Auto Parts
 Stade Enrg.
 Lac Megantic, Prosper Bouchard
 Laval Fortier
 Magog, Ferronnerie Robert & Frere
 Mistassini, Jos. Sasseville
 Montreal, Bernard Hardware
 Ferr Hochelaga
 Fredette & Frere
 Gagne Hardware
 J. E. Hubert Enrg.
 Ernest Mongeau Enrg.
 Mousette Ltee.
 Notre Dame Hardware Co.
 G. Poirier
 V. St-Onge Ltee.
 Pierreville, Shooner & Cie
 Rigaud, Rigaud Lumber Supply
 St. Antoine des Laurentides, Ferr St. Antoine
 Ste. Theresa de Blainville, Alc. Desjardins
 Ste. Genevieve de Pierrefonds, Andre Theoret
 St. Bruno, Ferr. St.-Bruno Enrg.
 St. Chrysostome, Blais & Freres
 St. Paul Ile aux Nois, R. Fleury
 St. Joseph de Beauce, Co-operative Agricole
 Shawinigan Falls, Alfred Belanger
 Tring Jonction, L'Invincible Syndicat Co-operative
 Trois Rivières, Ferr Laviolette Enrg.
 Ville La Salle, L. Doast Limitee
 Jacob Hardware Reg'd

SASKATCHEWAN

Lloydminster, Nelson Lumber Co.

YUKON TERRITORY

Whitehorse, Northern Commercial Co., Ltd.



"HOT TIPS"

for successful soldering by

Cummins®

A HANDY GUIDE — SAVE THIS BOOKLET!

Anyone can learn to use a Cummins Soldergun — and everyone can put it to use for a hundred and one common household, hobby or professional jobs. A few simple practice jobs will show you how it's done — and here are some easy-to-follow tips and suggestions to help:

1. Choose the right materials. The solder and flux chart shows what to use for various metals, with 50/50 solder a good all-round choice for most jobs. The first figure refers to the percentage of tin, the second to the percentage of lead in the solder. Thus "60/40" means 60% tin and 40% lead. Core solders with the flux "built in" are best for average use.

SOLDER AND FLUX TO USE

METAL	SOLDER	FLUX	METAL	SOLDER	FLUX
Black Iron	50/50	Zinc chloride or acid	Galvanized Steel	50/50	Acid
Brass	50/50	Rosin or acid	Lead	60/40	Rosin or acid
Bronze	50/50	Rosin or acid	Pewter	80/20	Rosin or acid
Copper	50/50	Rosin or acid	Stainless Steel	70/30	Glycerine
Electrical		Rosin	Tin	60/40	Acid
Connections	50/50	(NEVER ACID)	Tin-plated Steel	60/40	Glycerine

2. Keep it clean! Surfaces should be free of grease, paint, dirt or rust, or solder won't adhere. Use a wire brush, sandpaper or chemical cleaning agents on the surfaces.

3. Heat the work, not the solder. Solder should flow on for a strong, smooth bond.



4. Feed a little flux core solder at the point of contact. This serves as a heat conductor between tip and the work. Release trigger when tip is not in contact with work.

5. Remove tip by sliding it off the work — not lifting it. Otherwise you may lift solder off the work, in addition to leaving a rough joint.

6. Complete soldering of electrical connections quickly, to avoid burning insulation or contacts. Properly spliced wires (as illustrated) are essential to a good electrical connection.

7. Give the solder time to "solidify" before testing the joint or subjecting it to stress.

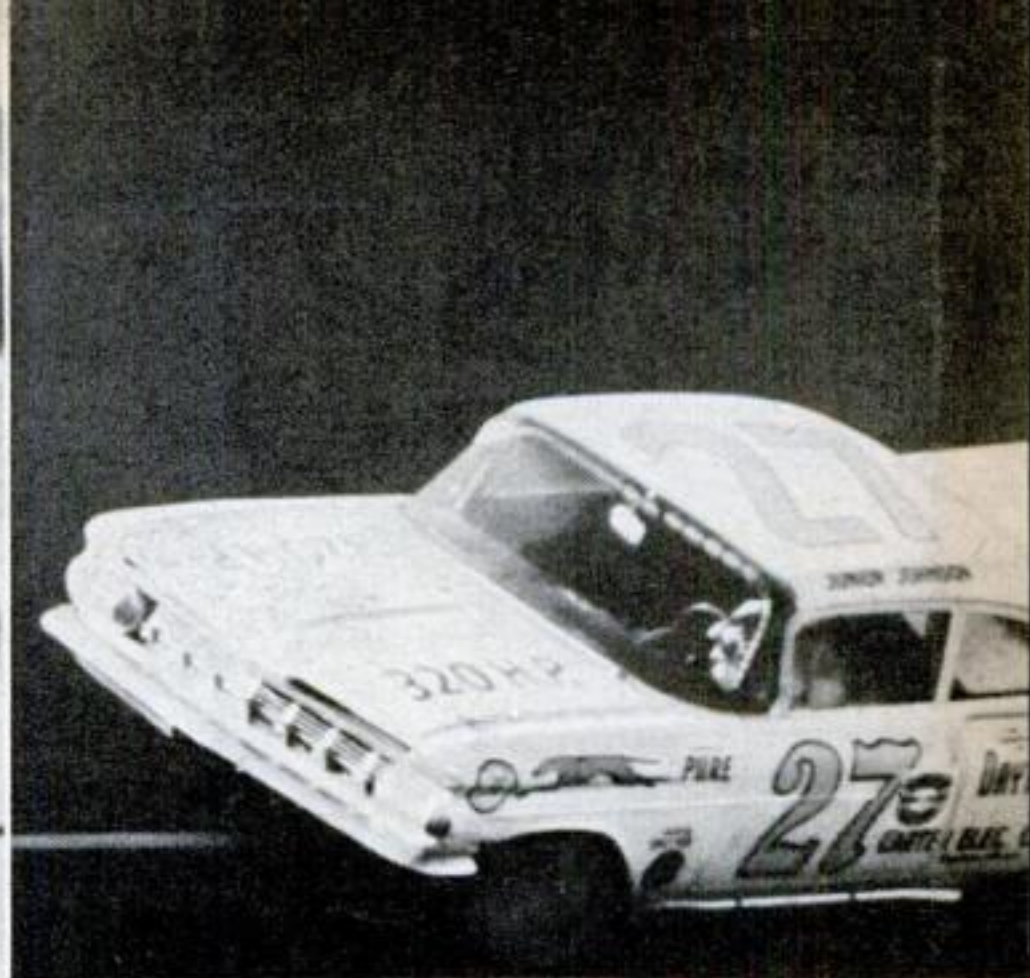
8. If acid flux is used, be sure to remove all traces of it immediately, to avoid corrosion.

Cummins Portable Tools, Division of *John Oster* Manufacturing Co., Milwaukee 17, Wis.

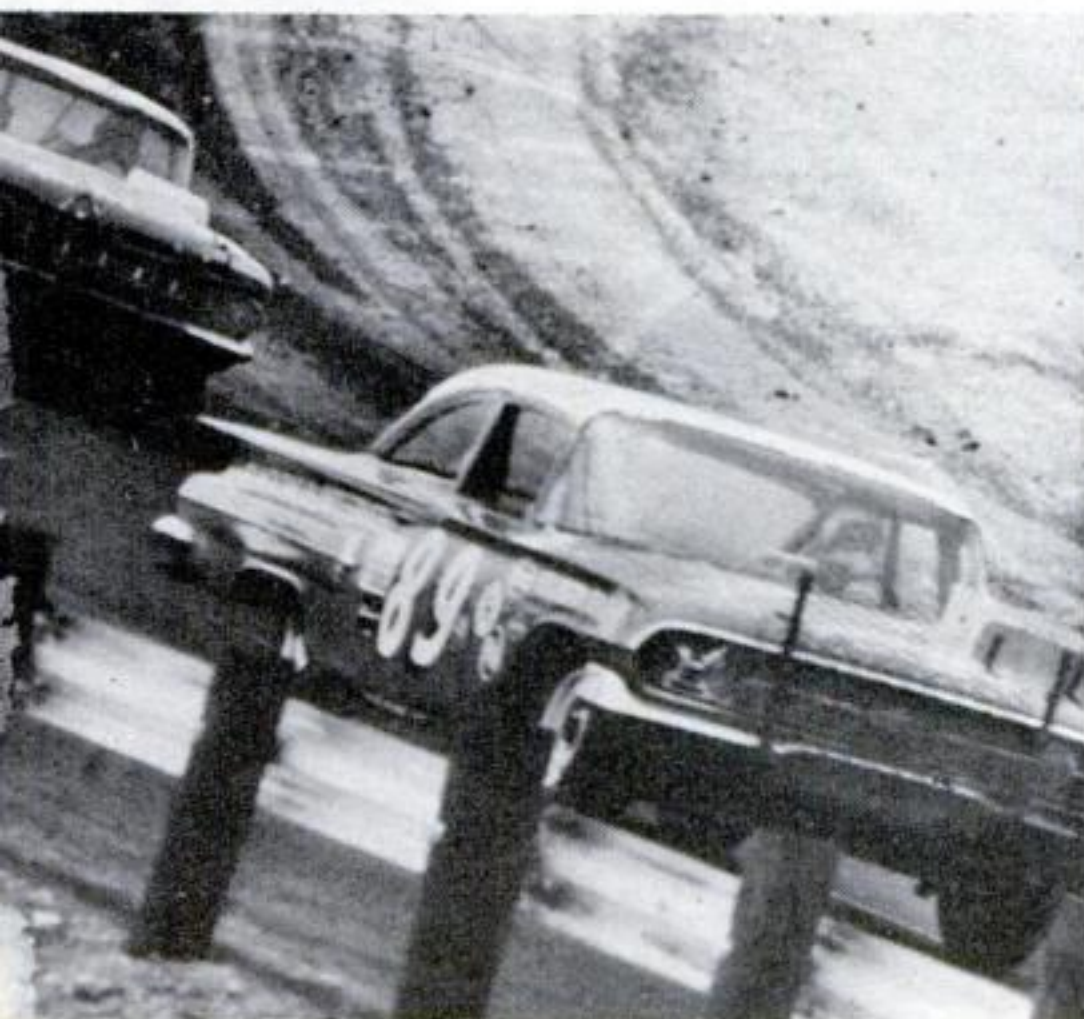
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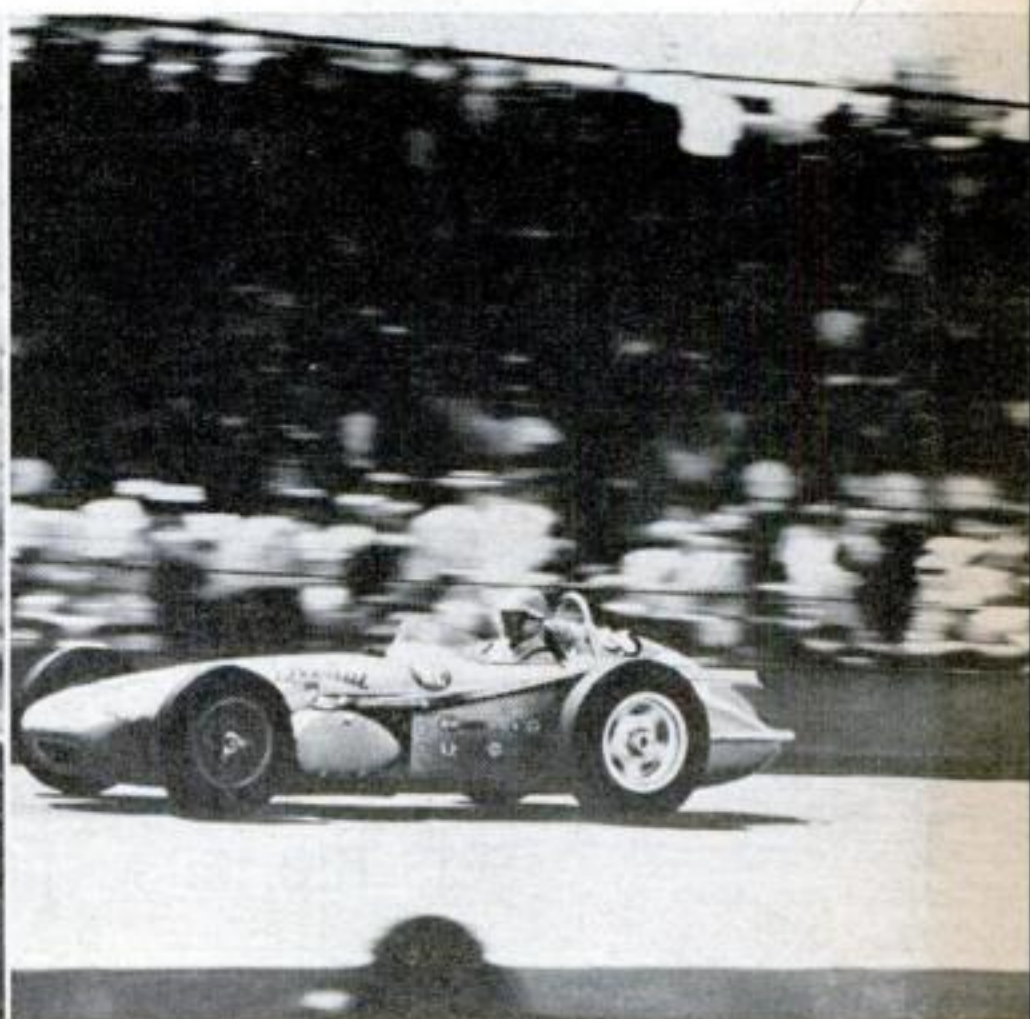
Winner at Sebring: John Bentley (above) Index of Performance winner, and 6 out of 10 class winners used Champions.



Winner at Daytona: Junior Johnson wins the 500-mile Sweepstakes. *Every* Daytona winner has used Champions.



Winner at Charlotte: Joe Lee Johnson wins the first World 600 with Champions. 8 of the first 10 to finish used Champions.



Winner at Indianapolis: Jim Rathmann sets a new record to win the "500". Like 10 of the last 11 "Indy" winners, he chose Champions.

Q. Why do winners of 9 out of 10 major races use Champion spark plugs?

A. Experts know they can depend on Champions to wring every bit of performance out of every drop of gas. Your car will perform better, too (and save money on gasoline) with new Champions. Put in a set every 10,000 miles.

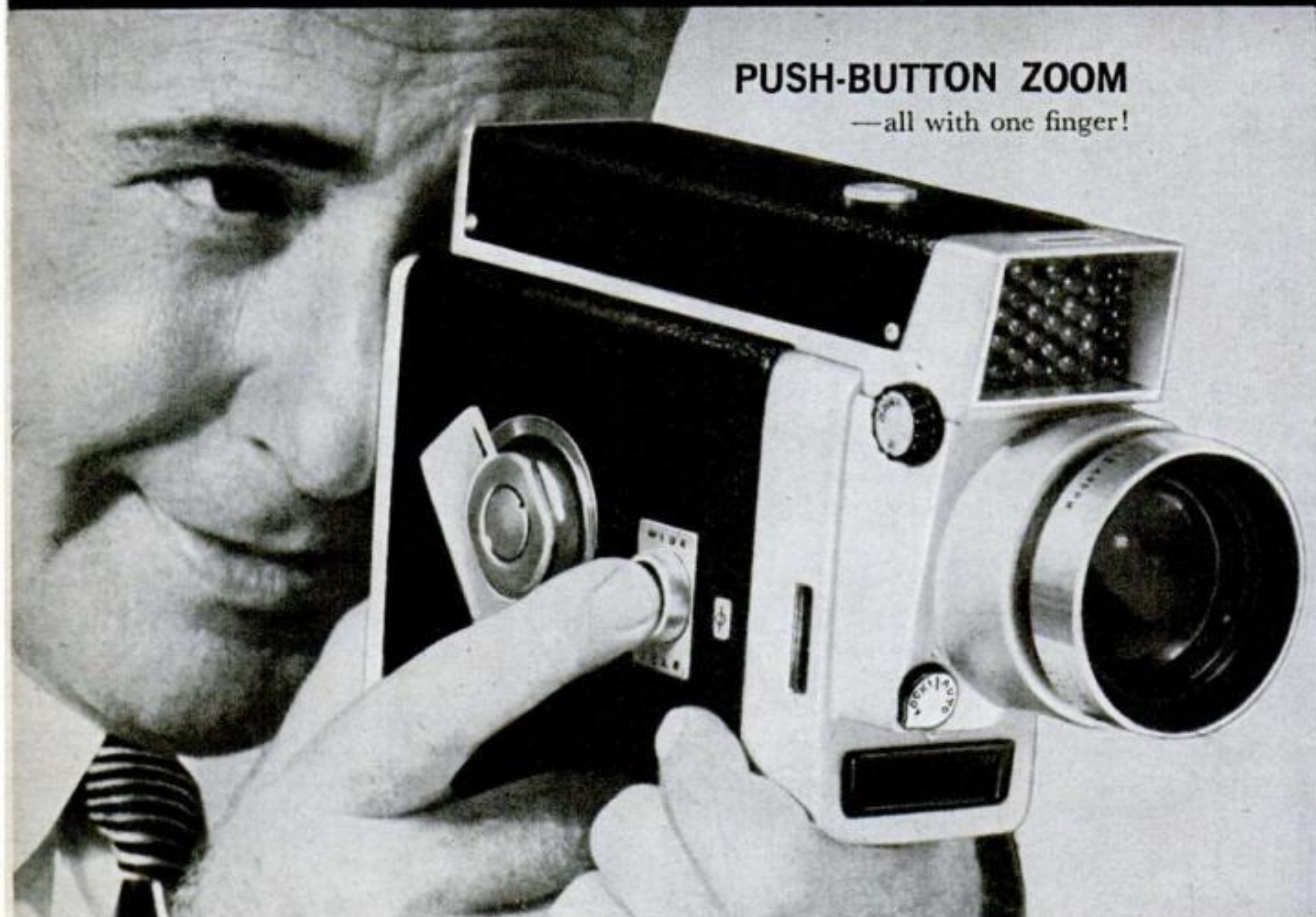
*Worn spark plugs waste lots of gas—
so check your plugs every 5,000 miles!*

CHAMPION



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New Ideas in Photography



PUSH-BUTTON ZOOM

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Look! A single button operates the camera and zooms your movies, too!

Z-O-O-O-M! Push button zooms your movies, electric eye sets the lens—new Kodak Zoom 8 Reflex Camera

Now! A push button brings you the most marvelous thing that's ever happened to movies—the zoom! You look through the finder and before your eyes people and objects suddenly swoop close and fill the scene. Or, starting with a close-up, the scene suddenly widens like opening the curtain on a gigantic stage.

Since you view through the lens of this new Kodak Zoom Camera, you see exactly what will appear in full, brilliant color on your screen at home—a wholly new and dramatic experience in movies you make yourself.

You can also zoom manually with this 8mm camera, or set the lens in advance at any position from wide-angle view to telephoto close-up, without taking a step. And the camera's electric eye makes all the exposure settings for you . . . automatically.

Inspect this remarkable new movie camera. You'll find it at your photo dealer's now. Price: less than \$190, or as little as \$19 down. See your dealer for exact retail price. Many dealers will take your old camera in trade.

Prices are subject to change without notice.

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from Kodak

POWER FILM WIND

—10 color shots in
10 seconds!



Listen! You can hear the film advancing automatically for the next shot!

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The new Kodak Motomatic 35 Camera power-winds the film automatically—quick as a wink. It's ready for the next picture instantly. Now you can click off sequence shots that tell the whole story. Catch that fleeting expression that so often happens just after you press the button.

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And imagine—automatic flash setting! Just set the distance, and the lens opening automatically adjusts for correct flash exposure!

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SEE KODAK'S "THE ED SULLIVAN SHOW" AND "THE ADVENTURES OF OZZIE AND HARRIET"

Kodak
TRADEMARK



Ch a Spook

By Martin Bunn

COASTING soundlessly through the open door, the black '59 sedan was inside the Model Garage before Gus Wilson, the proprietor, and Stan Hicks, his assistant, were aware of it. Equally surprising was the stranger who got out.

A small man in a somber black suit, he had a big nose, a bald head, and a standing slouch. He looked like a human caricature of a tame vulture.

"What can we do for you?" asked Gus.

"My left-turn signal does not work," said the stranger, his voice too big for his size.

"Let's see," said Gus. He switched on the key and flipped down the signal lever. The dash indicator stayed dark. So did the front signal lamp. The right-hand signal and indicator worked normally.

Gus found both front and rear bulbs burned out. He replaced them and checked the wiring for frayed spots. There were none.

"Had this trouble before?" he asked.

"Not in the two months I've had this car," boomed the little man. "But this is the first time I have taken it out on a case."

"Just wondered whether it could be a short," remarked Gus, "because both bulbs went at once. Probably not."

"I doubt it, too," remarked the stranger. "But I expect to be back."

He paid the small bill, hopped into the black car, and backed out.

"Now why," asked Gus of nobody in particular, "does he think he'll be back if there's no short?"

PRECISELY the same time next afternoon the black car rolled in once more.

"It happened again, as I foresaw," said the round-shouldered little driver. "Will you please make repairs? It is most important."

This time neither signal worked. Gus traced current up to the flasher, but it wasn't getting through.

"Your flasher unit is defective," he reported. "I can install a new one, but your real trouble may be a short."

"No, no," boomed the little man. "You will find none. But do check; it is vital to me to know whether you can find a reason for this difficulty."

Stan shook his head as the customer walked out. "I don't dig

RAY QUINCY



Startled, Gus dropped the hood and it crashed down on the roaring engine.

him, Boss. He's sure you won't find anything, but wants you to try."

"Looks that way," Gus admitted. Stan helping, he checked the whole lighting system. With the new flasher in, the signals worked perfectly. Wires were as good as new. The junction block on the radiator yoke was a bit askew, but all its terminals were tight. Battery straps and clamps which, if loose, might be causing voltage surges, were secure. A meter showed the charging voltage to be correct.

"So he's right," shrugged Stan. "We can't find a thing wrong—and I bet he'll be glad of it!"

Stan proved a prophet. The little man smiled knowingly when Gus reported that all checked okay.

"Very good indeed!" The bald, birdlike head bobbed delightedly. "Of course I shall see you again."

A BALKY automatic transmission made Gus forget his odd customer until, just 24 hours later, the black car reappeared, its driver strangely excited.

"A headlight burned out this time. Remarkable! I shall do a paper on this—with your confirmation, of course. Please check most carefully."

"We did last time," said Gus. "You seem to know something about this trouble that you haven't told us."

The bald head cocked sidewise. "Yes, I will tell you, although you may not believe." The little man's chest swelled. "I am Jonathan Rowen, an amateur psychic investigator, student of the mysteries of life and death. The past two nights I have spent—alone—on Eagle Crest."

"In the old Tolliver house, the one people say is haunted?" asked Stan.

"Precisely. The influence of its psychic phenomena extends to the foot of the mountain. It is there, when I enter the

private road, that my lights always fail!"

For a moment Gus was speechless. "You don't mean," he said at last, "that you think they're doused by—spooks?"

"Unless you can prove otherwise, Mr. Wilson, I shall so report to the Society for Psychic Research. And," concluded Rowen jubilantly, "I am certain you will not be able to."

Where'd it come from?



THE CHISEL: This tool has been traced back as far as the Stone Age—100,000 years ago. The first examples were very small, and made of bone or stone. They were probably used without handles. Later the chisel was provided with a tang so it could be fitted into a wooden shaft. Copper chisels appeared sometime before 3000 B.C. but didn't replace stone tools because they were too soft to be used on anything but wood. The metal chisel only came into its own much later in the Iron Age (beginning about 1200 B.C.), when metals of sufficient hardness could be made.

CHALLENGED by the little man's cocksure attitude, Gus rechecked everything he had done before. The socket wiring and ground strap of the burned-out headlamp were in good order. Even a high-voltage meter test showed no trace of a short circuit.

"Couldn't find a thing," Gus admitted when Rowen returned. "But I still think there may be a fluctuating short we just haven't traced."

"No, no, Mr. Wilson," protested Rowen delightedly. "This is your interpretation. But I know that the spirits may resent my intrusion, can be mischievous and even malevolent. Why should an electrical defect appear always—and only—on Eagle Crest road?"

"Let's find out," suggested Gus. "Suppose we go along and see what happens?"

"Excellent. I shall be delighted. Shall we start from here at eight?"

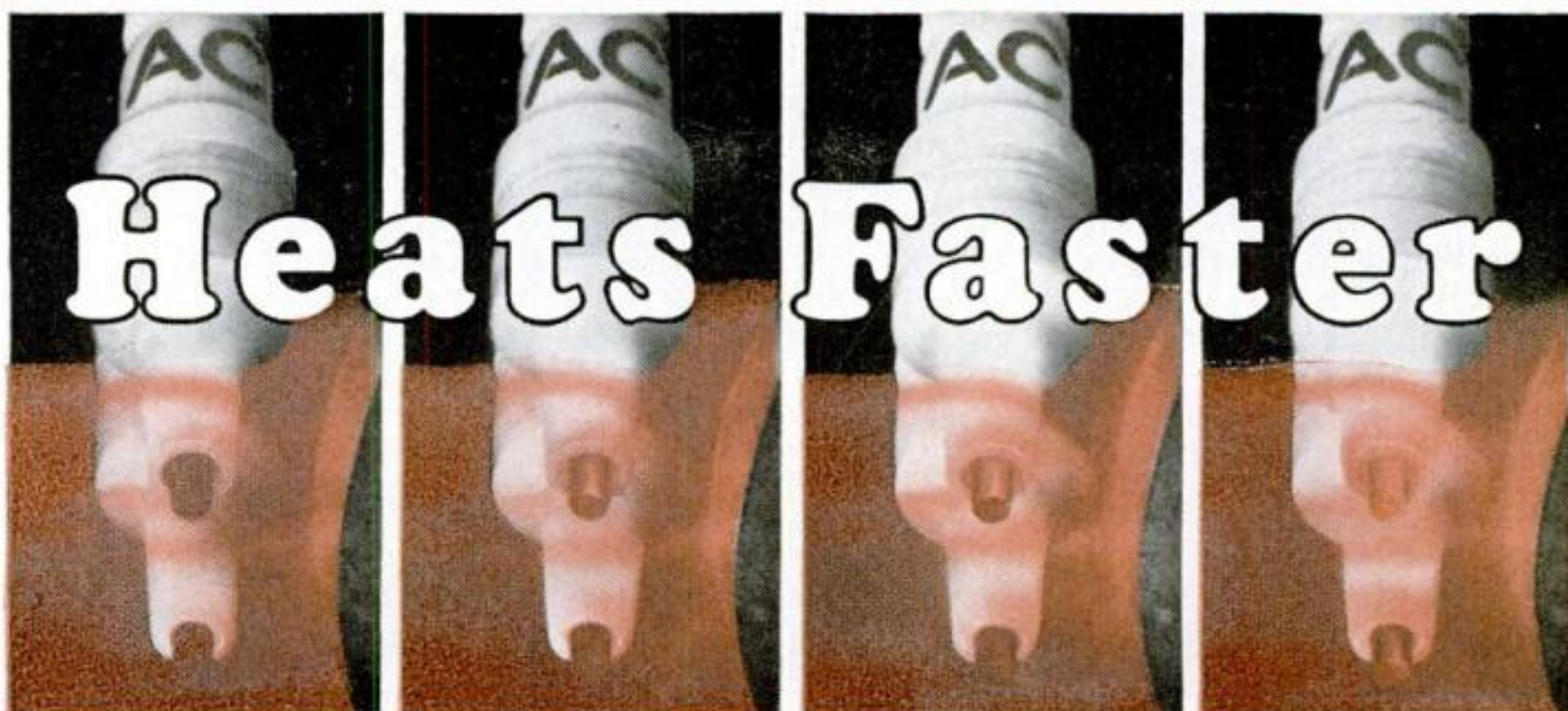
"**G**HOST hunters!" chuckled Stan as he and Gus awaited Rowen that night. "That's a new job for us to be tackling, Gus."

"I'm not hunting ghosts," growled Gus. "Just some tricky-wiring grief. You load those parts I told you to?"

Stan nodded as the black sedan rolled up. Gus got in, stowed a tool box underfoot. As they moved off he heard his own car follow, with Stan at the wheel.

Rowen's blinker signals worked fault-

BLOW-TORCH TEST SHOWS ADVANTAGE OF FAMOUS AC "HOT TIP"



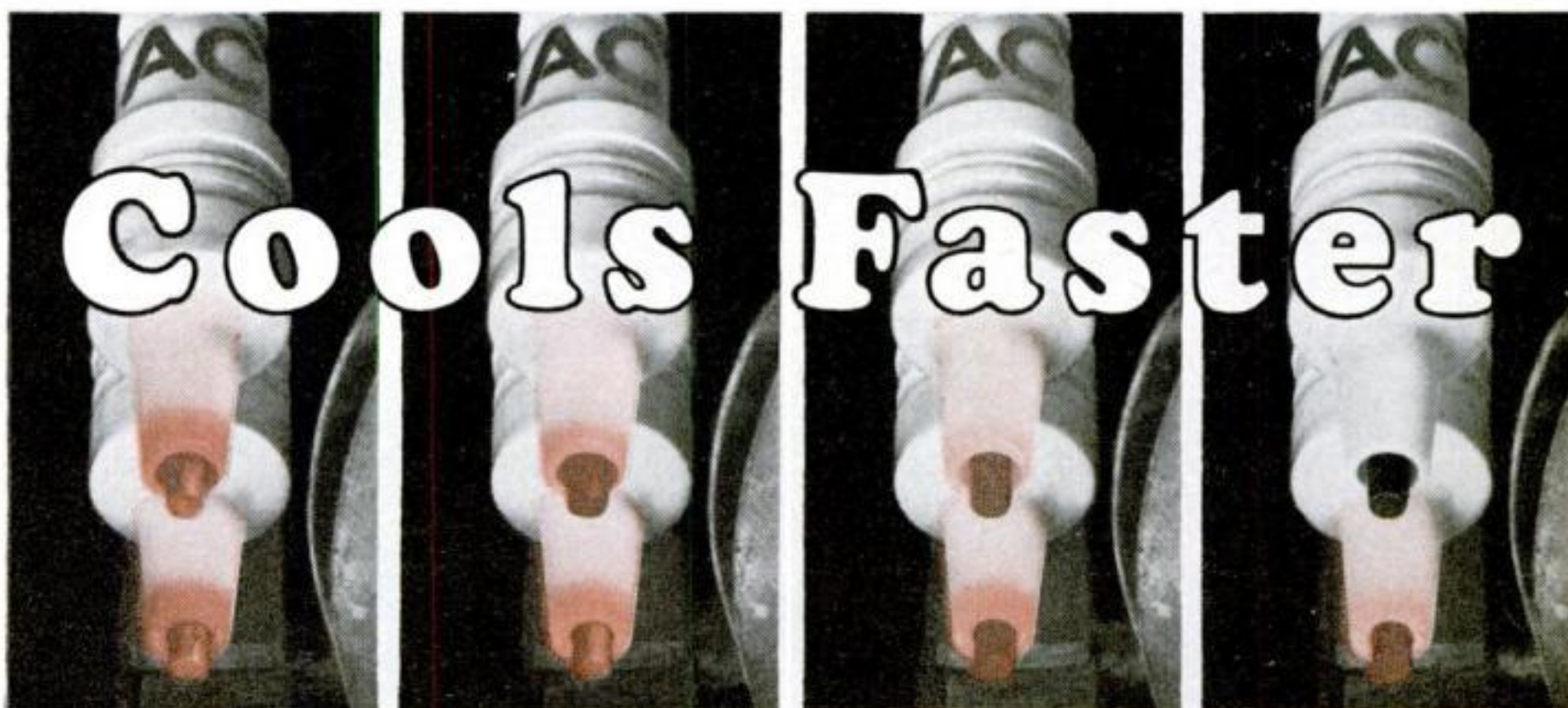
Heats Faster

Hot Tip (at top)

Heats Rapidly

Gets Hotter

Still Hotter



Cools Faster

Flame Removed

Tip Cools Rapidly

Gets Cooler

Still Cooler

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The faster heating action burns off combustion deposits . . . the faster cooling prevents engine-damaging pre-ignition . . . the long, thin, deeply recessed insulator design provides maximum clearance for "scrubbing action" by combustion gases to destroy accumulations as they form.

AC's "Hot Tip" means more miles of sure-firing operation and economy, with less cleaning and servicing. Next time you need spark plugs, ask for AC Fire-Ring Spark Plugs with the famous "Hot Tip."

AC SPARK PLUG  THE ELECTRONICS DIVISION OF GENERAL MOTORS

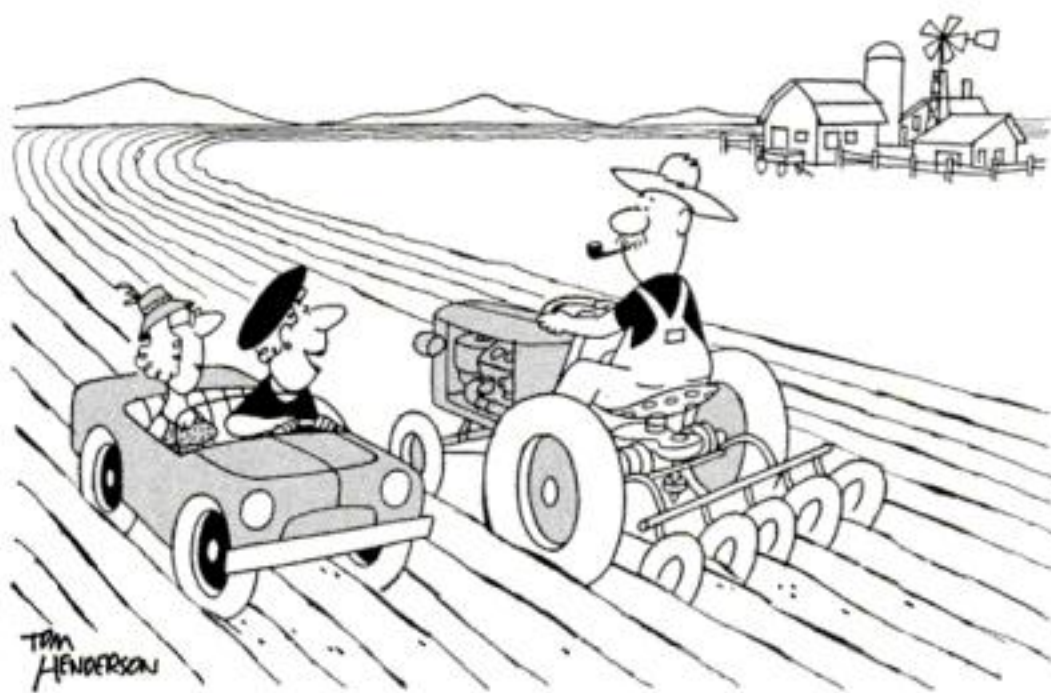
AC Fire-Ring Spark Plugs

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lessly in town and, later, when he signaled a turn off the parkway. A few miles farther on, a great stone pillar loomed up on the left side of the road. Rowen flicked the signal lever down, slowed not quite enough, and swung the wheel. The big car lurched over a gravel apron, almost bottomed on the ruts of a neglected dirt road.

"It's right here—" began Rowen, and interrupting himself, he pointed to the dash. The signal lever was still down, but the dash indicator had quit blinking.



"We're looking for Route 7."

He moved the lever to the off position.

"Stop right here," ordered Gus, and got out. Raising the hood, he asked Rowen to try the signal again. It worked! The left lamp winked in time to a red flashing at the rear. The engine revved up as if Rowen were eager to be away.

"What's up, Gus?"

Stan's breathless query—he had come up unnoticed—was so startling that Gus dropped the hood. It crashed down on the roaring engine—and the left headlight died. Rowen hopped out in high excitement.

"You saw! You are witnesses!"

"Change that sealed-beam unit," Gus told Stan. While his helper brought a new lamp from the other car, Gus flung the hood up, played his flashlight on the massive engine, traced the headlight wiring to the junction block.

All six terminals, as Gus well knew, were securely tightened. But in the powerful flashlight beam one end terminal showed a spot of discoloration. Gus wondered whether it had been there before

—the shop lights weren't as bright as the flash beam.

He swung the light around the junction block. Nothing could have touched the darkened terminal. Nothing ever came near it except the hood.

The hood—always up when he checked! With the flashlight, Gus sought out a small brace at the front corner of the upraised panel. On it was a tiny spot, black as if burned by an electric arc. Lowering the hood, Gus fingered the spot, felt the terminal below it.

"There's your spook," he told Rowen. "This junction block is high at one end. The hood doesn't touch it, but banged down or bounced by road shock, this brace shorts the terminal that goes to your left-turn signal."

"No!" The word was a blast of disappointment. "It would blow a fuse."

"Not this kind," explained Gus. "A come-and-go short like this doesn't last long enough. But it does cause sudden voltage surges that burn out bulbs."

Deflated, the little man turned away. Gus loosened the junction block and retightened it lower down. With the new headlamp in and the left blinker working, he slammed the hood. The lights stayed on.

"Sorry we scared away your ghost," Gus said to Rowen.

"The truth must be faced," said the little man in a sepulchral voice.

As he paid Gus, he slipped a card into his hand. "Perhap I can do something for you one day, sir."

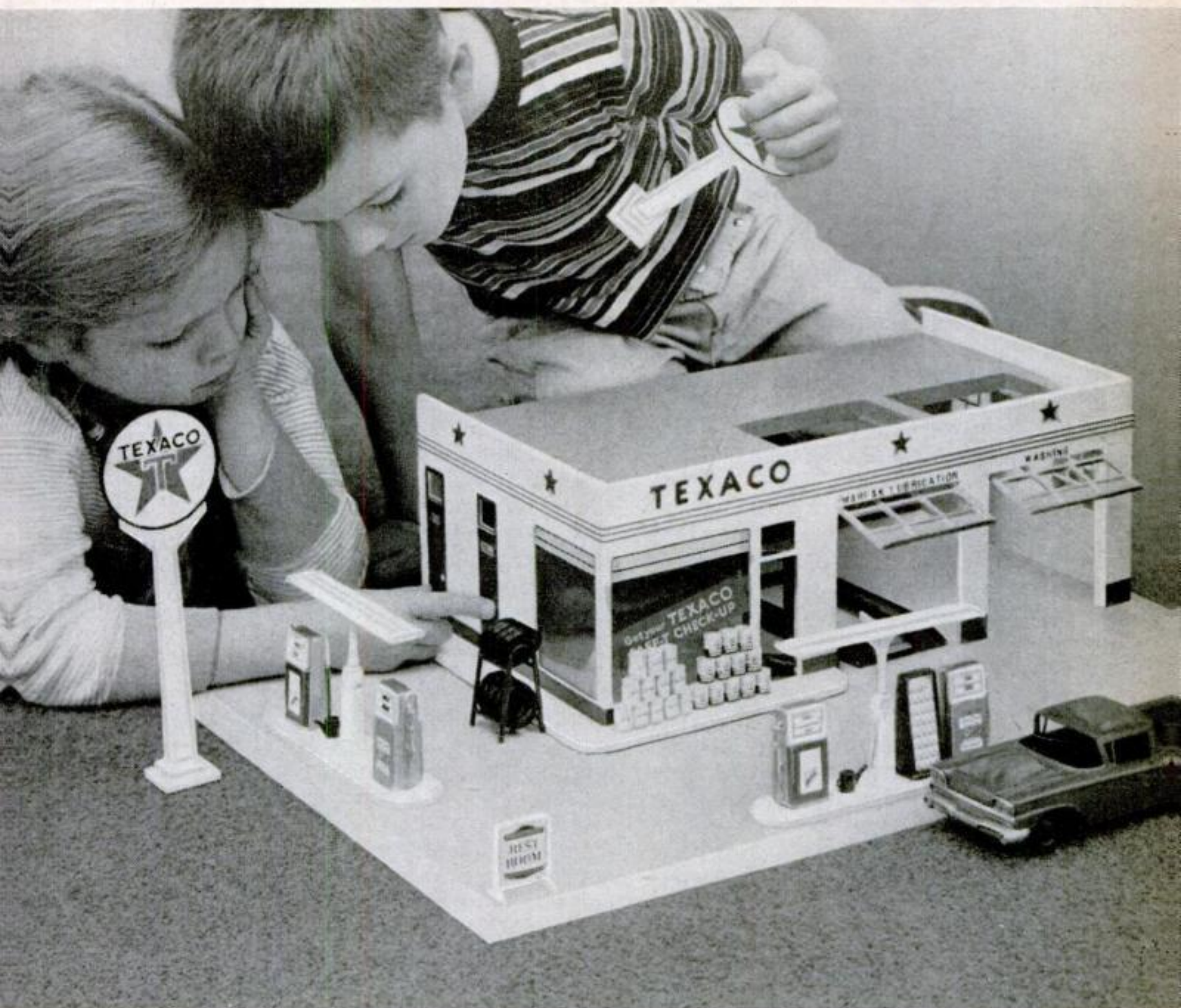
AFTER the tail lights of the big car vanished up the hill, Stan remarked, "One for Halloween, wasn't it?"

"Almost hated to spoil his ghost for him," Gus admitted.

"Oh, he didn't hold it against you, Boss. Even said he might do something for you. Wonder what his business is when he's not ghost-hunting?"

Gus turned the card over in the glow of his car's headlamps. He grinned at Stan wryly. "Mr. Jonathan Rowen is an undertaker."

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Raising Whales for Food

[Continued from page 76]

40- or 50-tonner. Whale milk is extremely rich in fats—much more so than cow's milk—and to enable her baby to grow at such a speed the mother must produce something like a ton of milk a day. This is a thought that should make a dairy farmer's eyes pop.

It was once believed that whales live to enormous ages—perhaps hundreds of years—and take correspondingly long to become mature. But it is just the opposite. A whale is full-grown at two, can be a parent at three, and has reached a ripe old age at 50.

Floating gold mines. All the facts and figures about whales are a little overwhelming, but here is one important to our argument: The value of the meat and oil products in a single large whale can be as much as \$30,000. No wonder that many nations send fleets of factory ships and catchers into the Antarctic each summer. And no wonder that they were threatened with extinction before international regulations limited the catch.

When you consider how farmers have improved the standard of all domestic animals by breeding them for desired qualities, it is obvious that whales provide us with wonderful opportunities. With our modern resources, we should have no great difficulty in taming, or at least controlling, whales. The first men to tame elephants, more than 2,000 years ago, faced a more formidable challenge.

Granted that it is possible to herd and breed whales as we do the much tinier cattle of the land, what would be the advantages? Well, we could steer them to new feeding grounds where they could feast on artificially fertilized crops, and grow more rapidly than they do under natural conditions. We could protect them from their natural enemies, the swift and ravenous killer whales. We might even train those fierce monsters to act as marine sheep dogs, herding our flocks for us. We could improve the amount and quality of the food products they yield and could eliminate today's cruel, wasteful methods of slaughtering.

It might also be possible to keep herds of milch whales, purely for the ton or so of milk they produce every day. Designing a milking machine for a whale would be an interesting engineering problem,

but not a very difficult one, for the whale does all the work. When her calf wishes to feed, which must be fairly often—it puts on weight at the rate of about 500 pounds a day—the mother whale literally squirts her milk into the baby's mouth in a high-speed, powerful jet. This forced-feeding technique has presumably evolved so that whale calves can suckle while submerged, without getting sea water into their mouths.

Whale milk, incidentally, is much too rich for direct human consumption, although one could probably acquire a taste for it. But it would be an extremely valuable source of fats and other foods, once it had been properly processed.

Riding herd. Some people may doubt whether it would be possible to get such enormous and powerful animals to obey our instructions and to do exactly what we wanted. However, the work already carried out in training porpoises shows how intelligent and cooperative the marine mammals can be. Whales and porpoises belong to the same order of the animal kingdom—the cetacean. In any event, it may soon be possible to control even the most untamable creatures by passing weak electric currents into the proper areas of their brain. This has been done experimentally with monkeys without causing any harm or distress to the animal. So we may develop some kind of radio-control unit for whales, permanently installed on the leaders of the herds, which would be switched on when we wished them to carry out our orders.

In a novel called *The Deep Range*, I tried to describe how "whale ranchers" some 50 years from now would use midget submarines to control and protect their great beasts. The parallel with the old-time cowboy is obvious, but it cannot be taken too far. The ranches of the sea will not be fixed, for they will move from the polar regions to the equator with the seasons. Such old-fashioned ideas as whale rustling, or shooting it out with the boys from the rival ranch, hardly fit into this picture. But the life of a 21st-century whaleboy would still have plenty of excitement, even though he may use an atomic-powered submarine instead of a horse, and curtains of electric impulses in place of a lariat.

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Wilson speaks coldly, methodically, from his war room in the sky. He contacts surviving Air Force units, here and abroad, and individual planes. There are terrible gaps in the communications, showing him that missiles or bombs have been there first. As this contacting is going forward, the four other members of the control team are collecting and interpreting battle-damage reports from SAC units that have gotten safely into the air and are available to General Wilson as striking units.

The second-by-second progress of the enemy attack—and the American counterattack—is plotted on a board for General Wilson to see. He does not fumble or hesitate. He knows his basic plans, he knows the best alternates, he knows—through many practice sessions—what to do under the changing conditions. He does these things, conducts the counterattack from his airborne command post, invulnerable to missiles, seven miles in the sky over the center of the U. S.

That's the way the airborne command post would work for real. Bill Morris and I took our ride with General Wilson, Colonel Lewis, and their staff to observe the practice operation first hand.

Patching through. General Wilson contacted more than 70 SAC bases, all over the world, with success. He was unable, because of atmospheric disturbances (or possibly because the planes were operating under mandatory radio silence), to contact three planes flying in a distant area. An aide explained to us that these planes could, and would, have been reached in a real emergency, by patching through ground stations. When I first listened in, by plugging into a jack on the switchboard, I heard only howls, squeals, garbled voices.

In response to my obvious disappointment, General Wilson said, "Here—take my seat at the control table. Colonel Lewis, over there, will brief you. Then tell me what you think."

I took the General's seat and put on his headset. Colonel Lewis, a no-nonsense type with a jutting jaw and hot blue eyes, explained that I must work the intercom with my foot to transmit to him.

"When you were on the panel back

there," Lewis explained, "you were hearing six or seven channels coming in all at once. Those boys on the board fish around for the best—and give it to us—all by itself. Let me show you. Where would you like us to make contact?"

"How about Guam?"

Colonel Lewis spoke briefly, using a code name I'll call Hula Hoop. Within seconds a voice said, "This is Hula Hoop. Go ahead, Private Eye."

"How do you read me, Hula Hoop?"

"Five by five!" [perfect reception] the voice from Guam said. "How us?"

"Five by five," Colonel Lewis answered. "Private Eye, out."

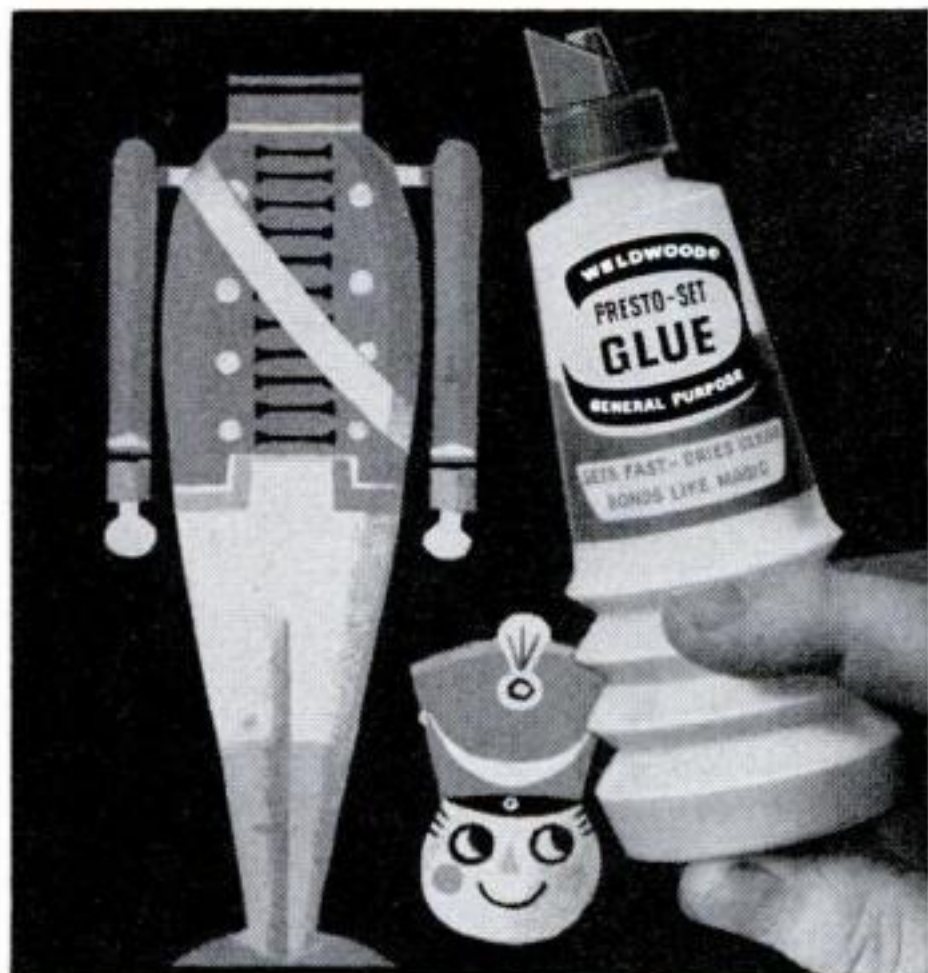
He then talked to Europe, Africa, and Greenland, with good results. Some were five by five. Some weren't so good. But all were clear enough to be understood, as were our transmissions to them.

To the other side of the world. This flying command post is still very new in SAC. The flight Bill Morris and I took was a training mission as well as an operational back-up. They ran through all the contacts they'd have to make in an actual counterattack, from the war room under the Pentagon to the remotest controllers on the other side of the world. They issued coded orders to bombers and tankers to simulate an emergency take-off (stopping the takeoff before it was airborne). Awkwardnesses in communication or teamwork were noted.

By "patching," the KC-135 can seize and use all normal ground communications systems available to the big war room at Offutt: telephone, teletype, TWX, and the like. A new paper-tape system was being evaluated during our flight. It takes down messages in printed form, eliminating the chance of errors when static is bad—and providing a record for later study.

If an international crisis arises, SAC has plans ready to keep an airborne command post aloft at all times. Three KC-135s are already fitted out with the necessary communications equipment and are standing by at Offutt. In case the tanker should have to land at a remote field because of fuel starvation, its auxiliary power units could even supply power enough to run the radios (and the war) from the ground.

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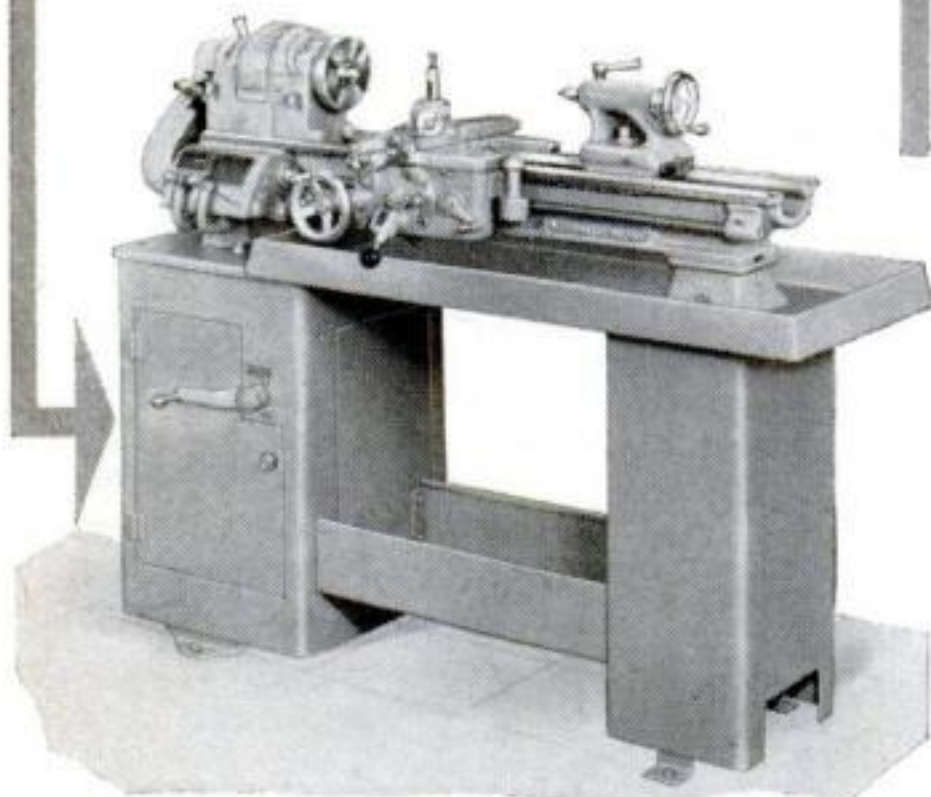
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New Polaroid Camera Thinks for Itself

[Continued from page 81]

mount is a sliding switch that you position for each exposure's lighting conditions. If it's an indoor (available light) shot, you set the marker on daylight, night illumination with ordinary bulbs, or fluorescent. If you're outdoors, you take the picture with the switch on "Normal." You can lighten or darken subsequent prints by moving the switch right or left; this slides a variable-density optical wedge in front of the photocell. Also, with Polaroid's just-released 10-second film, the amount of time you let the picture develop in the camera affects the contrast. Halt the process at 10-15 seconds for medium contrast; let it go on up to a minute for a very dark print.

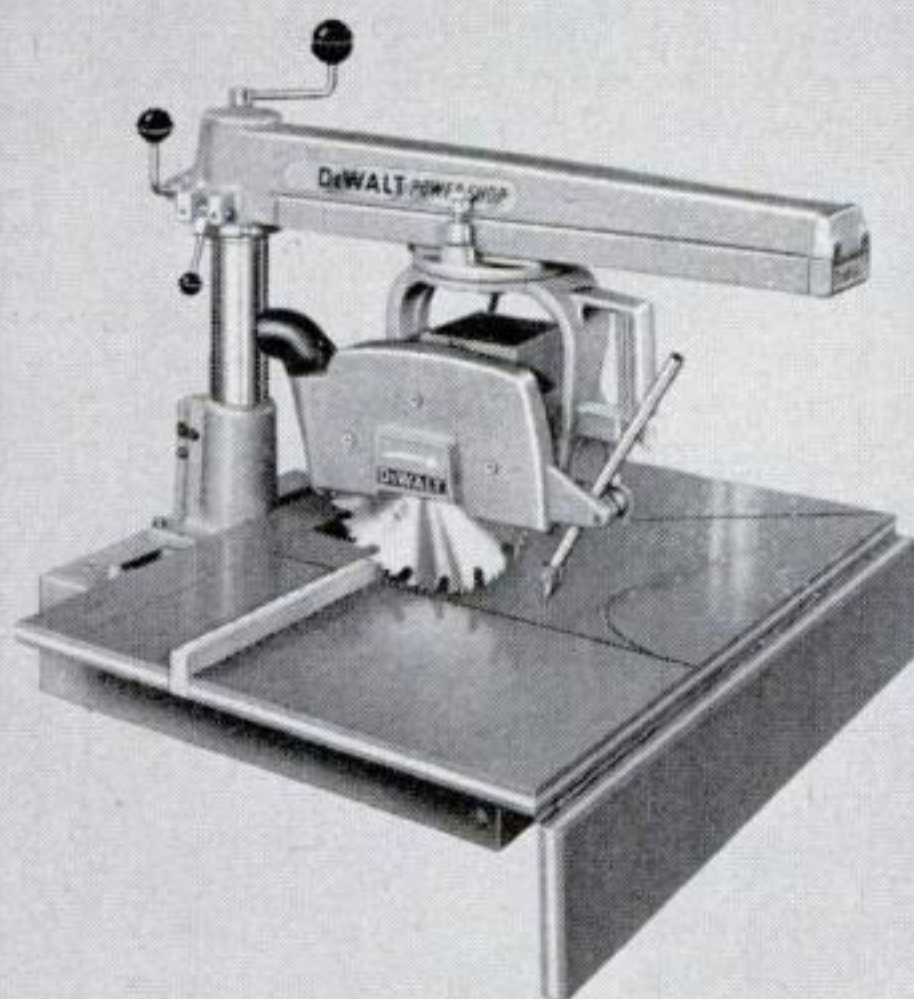
These are about the only controls you can exercise. The camera takes everything else on itself—unless you disengage the automatic mechanism by clicking another switch to "Manual." In this case, you must set the camera for one of Polaroid's familiar EV (exposure value) ratings; but such rash independence is best reserved for flash and time exposures.

The sensitive eye. When you cock the shutter, the camera awakens. A window $\frac{3}{16}$ inch in diameter opens above the lens to reveal a tiny cadmium-sulfide cell. This electric eye, in itself, is news. More sensitive than the 100-times-larger selenium cell common to other automatics, it represents a major improvement in photometer design. It is photo-conductive rather than photo-voltaic; in measuring the brightness, it varies the current passing from a button-size mercury battery to a moving-coil galvanometer. The more light, the more current the cell passes and the more the coil revolves. Its final position determines both lens opening and shutter speed. Our exploded diagram shows this simultaneous action.

Even after the picture has been snapped and the eye has reclosed its lid, the camera isn't asleep. Pulling the film tab alerts its darkroom. Count to 10 and you can open the back and peel off the developed print. The picture area will be exactly what the range finder framed for you; the exposure will be whatever the camera decided on. If you feel a bit guilty accepting the praise for the finished product, brazen it out. One thing the 900 *can't* do is protest.

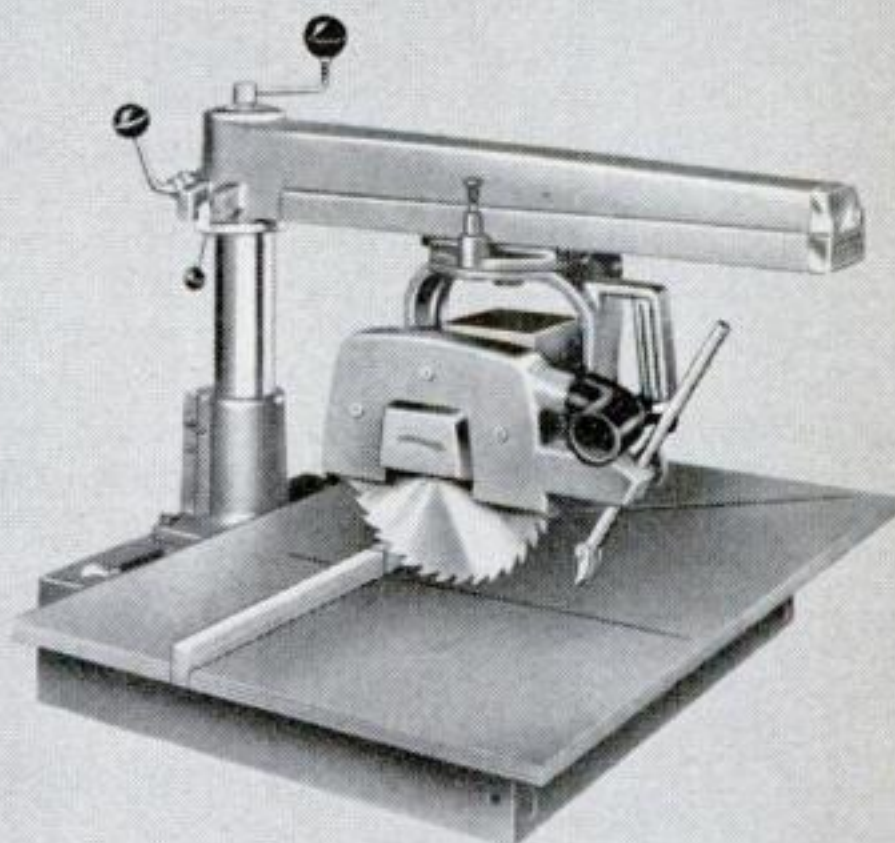
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Gadgets to Gyp the Gullible

[Continued from page 102]

After fastening a couple of electrodes to the patient's clothes, with wires running to plugs in the panel but not connected to any circuit, the operator goes into his act.

Having first put sweet oil on the fingertips of one hand, he begins stroking the fiberboard disc with them. Presently, the viscosity of the oil thins out and his moving fingers start to squeak.

"Aha!" exclaims the operator. "I'm now in tune with your disorder."

He checks the dial settings, which he had arranged in advance, and consults a code book to find out what they mean. They're in the book, all right, and after them lies an explanation. The disorder is revealed, and alongside is the prescription for it (colored sugar pills or bile salts).

The man generally credited with starting the cult of diagnostic machines was Dr. Albert Abrams of San Francisco who claimed that he could tell what was wrong with anybody just by analyzing a drop of his blood, sent to him soaked into a clean white blotter. The blotter was

then submitted to his diagnostic machine for a verdict.

Though Abrams died a millionaire, things haven't been going as well for his imitators, who pop up every now and then. One got his come-uppance when a Public Health Dept. inspector sent him a drop of blood from a freshly killed rooster and received a diagnosis of "severe sinusitis."

Booming uranium. Today, radioactivity is all the rage in pseudomedical circles. Uranium-mine rubble, with less radioactive energy than the luminous dial of a wristwatch, is packaged in pillows, mattresses, and leather bags, and stealthily sold as a curative for ills, especially cancer and arthritis. If it were more radioactive, it would be dangerous. As it is, it's merely as useless as plain dirt.

Then, only a few months ago, the U. S. Food and Drug Adm. nabbed a most curious device that was being turned out in an Arizona kitchen. It was a little circular container, made of Plexiglas, that looked quite like an inkwell. The hole in

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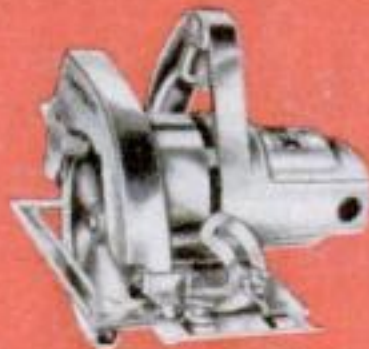
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Gadgets to Gyp the Gullible

the middle, lined with fine brass mesh, held an ordinary test tube. Eight tiny holes in the rim of the receptacle were filled by slender tubes of highly diluted radioactive chemicals in powder form.

The purpose of all this was to expose a sample of a person's blood, in the test tube, to 24 hours of radiation. After that, the blood serum was to be put back in the person. This, it was claimed by some who used the device, would provide "adequate and effective treatment" for arthritis, diabetes, anemia, cancer, and numerous bone ailments.

Medical experts testified that the device had no therapeutic value whatever. Physicists declared that the small amount of radioactivity to which each blood sample was exposed could have no more effect on it than the beam of a flashlight. However, they warned, anyone who handled the equipment regularly ran the risk of unconsciously ingesting from 10 to 50 times more radium than he could safely take during a lifetime.

Nothing stops promoters. Scares, fines, and jail sentences for the builders and

sellers of mechanical fakes haven't put them out of business. One big difficulty is that few victims squawk. Many are ashamed to admit that they have been gulled. Sadder are the cases of those who haven't yet lost faith in the worthless machines and gadgets they have bought, and are wasting vital time in which they should be getting proper medical care.

The shrewdest quacks don't advertise in print, for that would most easily lead the authorities to them. Instead, they are great joiners and talkers, insinuating themselves into social clubs and gatherings of elderly people, and suavely spreading the word that they alone have the key to glowing health.

They tend to flourish in California, Florida, Arizona, and southern Texas. As one official of the U. S. Food and Drug Adm. bitterly commented, "Wherever old people accumulate to enjoy a mild climate, these harpies appear."

Even George Washington, enjoying the mild climate of Virginia, is said to have been sweet-talked into buying one of the nation's earliest quack gadgets.



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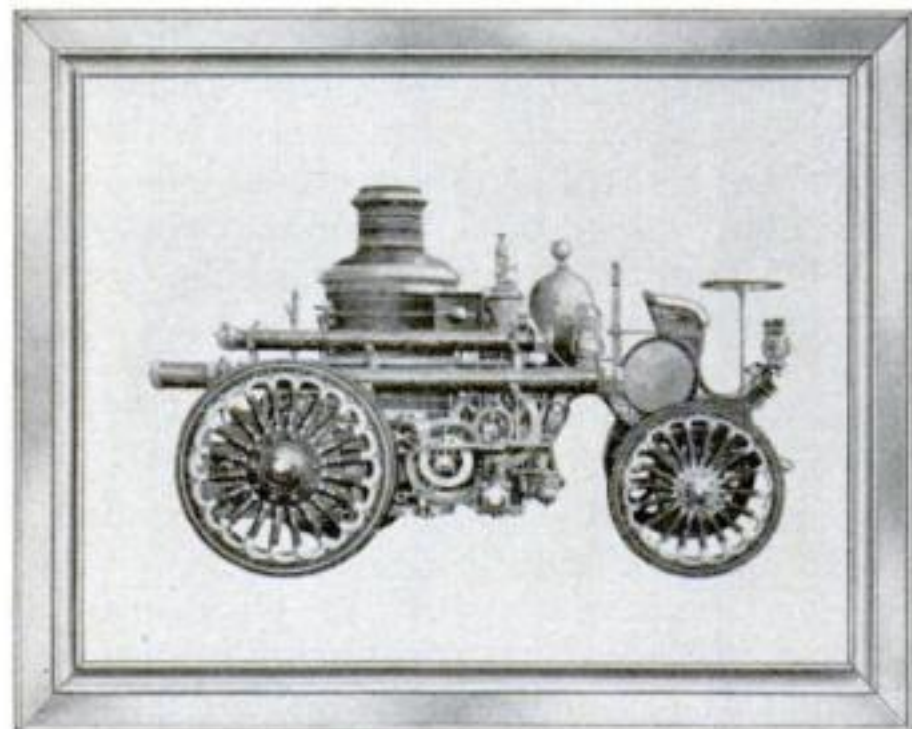
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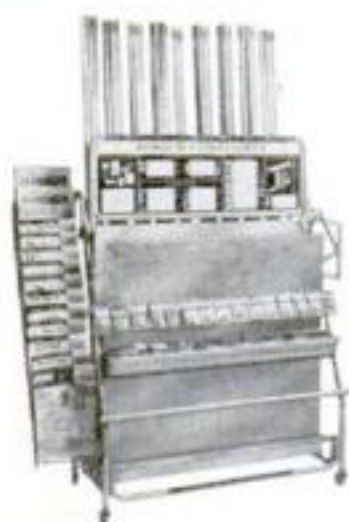
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No Flame, No Smoke, No Chimney

[Continued from page 136]

Where all resistance coils are in the furnace, they come on in sequence, typically 10,000 BTU at a time, and go off the same way. Thus there is never a sudden load hike or load drop, and the flow of heat can be fully modulated.

Ducts for electric furnaces can be overhead, or in a slab or crawl space. Basements are not favored for any type of electric heating. They're too expensive to heat, and ducts can't be run through cold, uninsulated areas.

Oil moves ahead, too. Jolted by the new competition from electricity and continuous ground-gaining by gas, oil-development engineers have come up with a glittering array of new equipment that promises better, easier, and cheaper heat from their fuel than ever.

The biggest advance is the pressurized flue. This creates a mechanically produced draft instead of relying on a chimney. UL approval is expected soon for a four-inch flue that may cost even less than a gas vent. It can go right out through the basement wall, like an automobile exhaust. Since heat is no longer lost through the chimney, fuel consumption is cut about 25 percent.

A safe prediction is that within five years no oil burners will use a chimney for draft. Gas furnaces, however, can't eliminate this big heat loss. They must have natural draft for their pilots and for carrying off any raw gas leakage when they aren't operating.

Jet-Heet, which last year introduced a new pressurized-flue furnace that works on jet-engine principles, now offers a water heater for use with it. This heater is touted as the lowest-priced and cheapest-operating unit ever marketed. The usual warm-air furnace doesn't reach high enough bonnet temperatures to heat water. Jet-Heet, three times as hot, produces cheap hot water in quantity. Also offered by Jet-Heet is a new thermostatic register. It controls heat output in each room individually, and needs no electricity or wiring.

Iron Fireman, another of the pressurized-flue furnaces, now has a horizontal model and a boiler that works by the same system. For hot-water heating systems, Dynatherm also has introduced a pressurized-flue boiler.

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Stewart-Warner, manufacturer of the already-fuel-thrifty, low-pressure Winkler burner [PS, Feb. '59], has found another method of eliminating expensive up-the-chimney heat losses. The new Winkler burner still uses a chimney, but has a shutter to seal it off when its draft isn't needed for combustion. The burner is available both in new furnaces and boilers, and as a conversion burner for replacement on existing equipment.

Featherweight liners. Look for the weight of all furnaces to be reduced by at least 50 pounds. Furnace liners of refractory brick are out. New ones are made of a lightweight mat of fibrous silica and alumina. They cost less, are easier to install, can't break, last indefinitely. Most important, they reach incandescence almost as soon as the burner fires up. Conventional ceramic liners are slow to heat; while heating they lose about 20 percent of usable heat in soot and odor.

Also money-saving is the new use of 1/4-inch tubing in hot-water heating systems, just announced by the Institute of Boiler and Radiator Manufacturers. The tiny tubing, which can be snaked through framing, eliminates need for all fittings except at the main and radiators, and cuts cost of risers and returns without any loss in heating efficiency. An estimated \$150 is saved in an average installation.

No more dry air. Forced humidifiers for the first time make it possible to give house air all the wintertime moisture it needs. If you've been waking up every winter morning with a parched mouth and scratchy throat, dry air is doing it. Harsh, dry air is known to be an important factor in producing colds, sinus troubles, and neuralgia. It also harms the house structure, unglues furniture, and makes plants droop and pianos go out of tune. If you draw sparks when touching metal after walking on a rug, blame that on dry air, too.

The new forced humidifiers can vaporize gallons of water per day, as against the pints or quarts that previous humidifiers could handle. With properly humidified air, you not only feel more comfortable, but you are comfortable at lower temperatures. For every degree you turn down the thermostat, you cut three

CONTINUED

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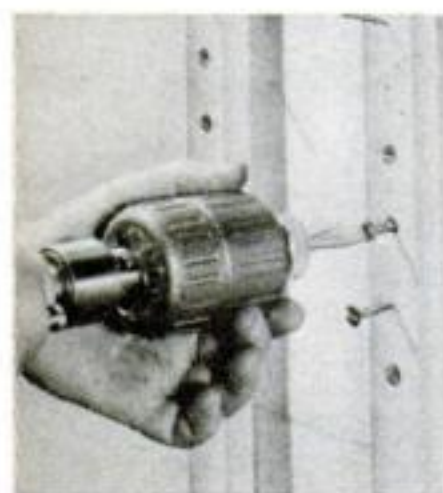


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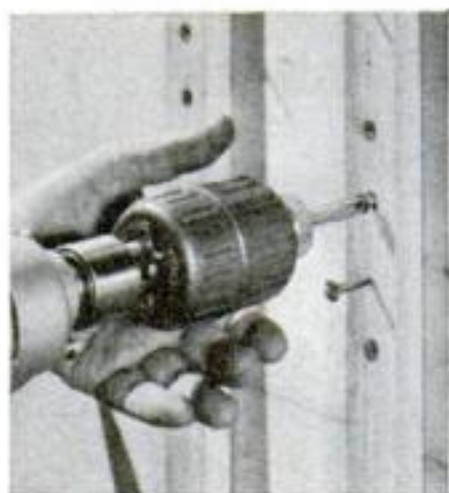
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Typical of the best among the new humidifiers are those made by Walton Laboratories. They atomize water mechanically, forcing moisture into the air

NEXT MONTH: TV Tuner Repairs

Watch for the third installment in the new series, "Expert Advice on Fixing a TV Set," coming in December PS. Art Margolis will tell you how to get top mileage from a TV tuner, the part that selects the channels. Attention to your tuner can prevent or cure a number of vexing TV troubles.

when a controlling humidistat calls for it. Cost: about \$165 installed. Operating cost: next to nothing.

Most humidistats use a 150-strand human-hair element that costs about \$10. New, too, are "climate-control centers" that bring temperature and humidity controls together in one panel for easy monitoring. Price: \$75 and up.

Figuring the insulation. If you are building a house or adding to your present one, no matter what kind of heating you plan, take your cue from the electric-heating people. They have shown clearly how much you can save on fuel and the size of your heating plant by thorough insulation.

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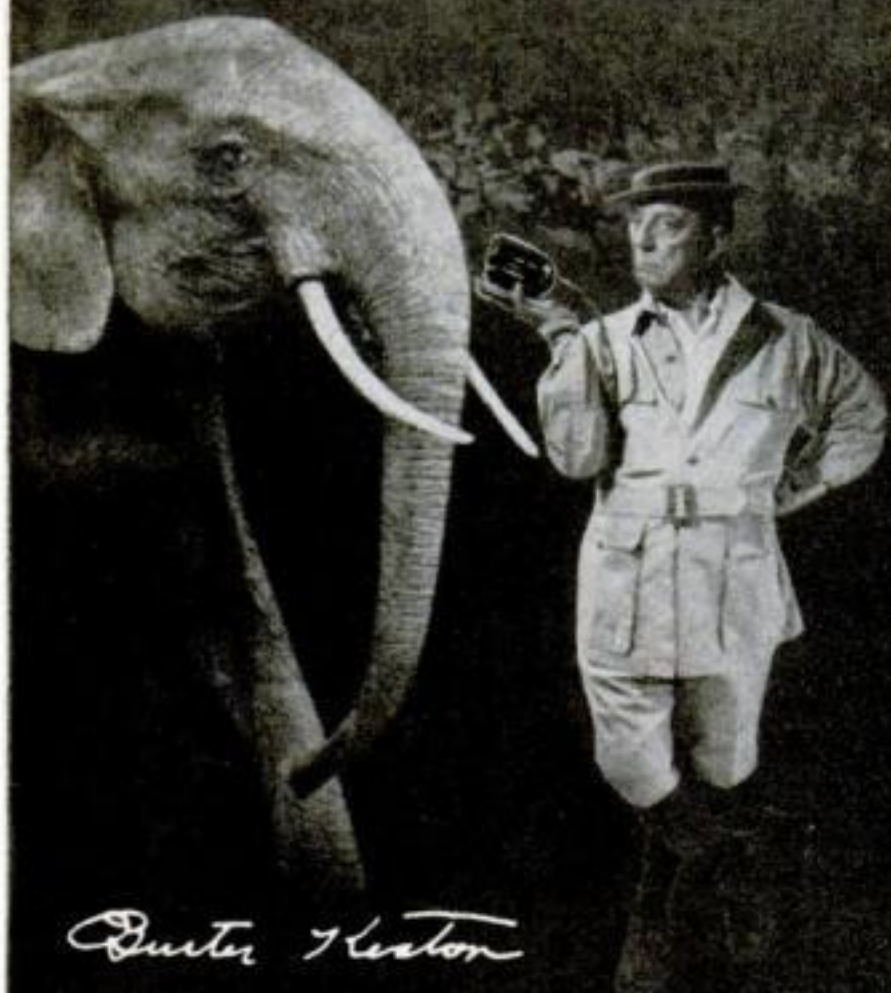
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WEN PRODUCTS, INC., 5810 Northwest Hwy., Chicago 31, Ill.

How to Build an Auto Smaller Than a Dot

[Continued from page 116]

usual way, until this lead screw was, at its scale, as accurate as our original lead screws, at our scale.

We can make flats by rubbing unflat surfaces together in three pairs—and the flats then become flatter than the thing you started with. So we improve the equipment by working awhile down there, making accurate lead screws, Johansson blocks, and all the other materials that we use in accurate machine work at the higher level.

WHEN I make my first set of slave "hands" at one-fourth scale, I am going to make 10 sets. I wire them to my original levers so they each do exactly the same thing at the same time in parallel. Now, when I am making my new devices one-quarter again as small, I let each one manufacture 10 copies, so that I have 100 "hands" at the $\frac{1}{16}$ size.

Where am I going to put the million lathes that I am going to have? There is nothing to it; the volume is much less than that of even one full-scale lathe. If I made a billion little lathes, each 1/4,000 the scale of a regular lathe, there would be plenty of materials and space available. In the billion little ones there is less than two percent of the materials in one big lathe.

There is the problem that materials stick together by the molecular attractions. After you unscrew the nut from a bolt, it isn't going to fall down, because the gravity isn't appreciable; it would even be hard to get it off the bolt. It would be like those old movies of a man with his hands full of molasses, trying to get rid of a glass of water.

But ultimately we can arrange atoms, the very *atoms*, all the way down!

Up to now, we have dug in the ground to find minerals. We heat them and we hope to get a substance with just so much impurity. But we must always accept some atomic arrangement that nature gives us. We haven't got anything, say, with a "checkerboard" arrangement.

WHEN we have some control of arrangement we will get an enormously greater range of properties that substances can have, and of things that we can do.

CONTINUED



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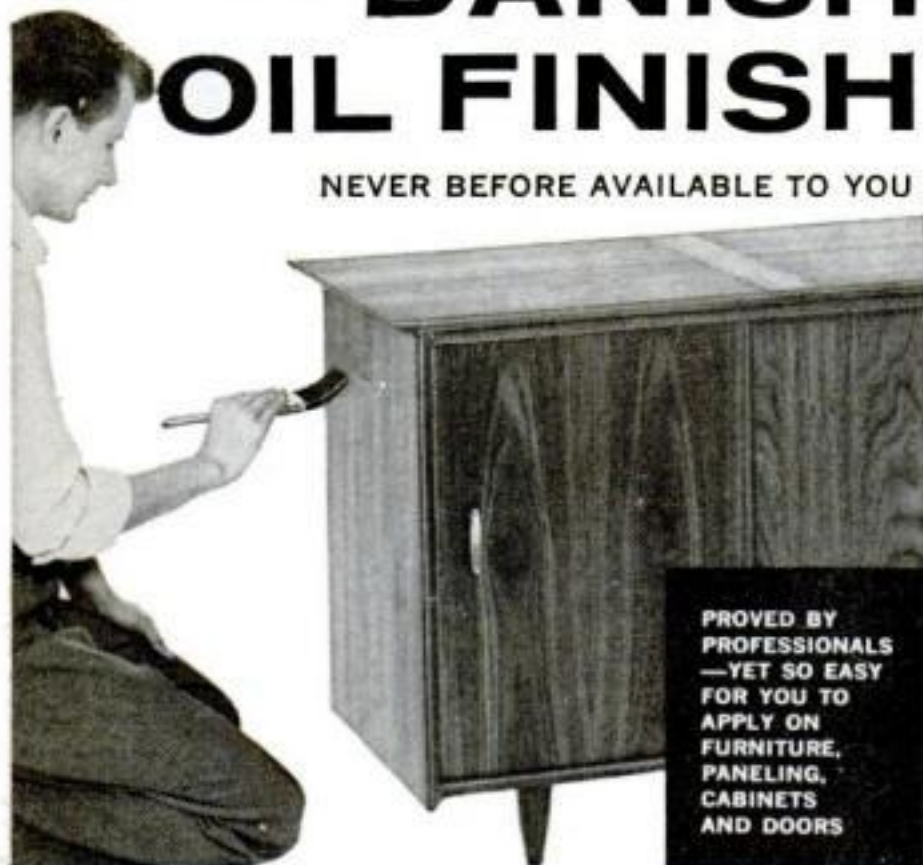
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How to Build an Auto Smaller Than a Dot

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Is it possible to get a whole set of antennas to emit light as an organized set of antennas emits radio waves to beam the radio programs to Europe?

If we go down far enough, all our devices can be mass-produced so that they are absolutely perfect copies of one another. We cannot build two large machines exactly the same. But if your machine is only 100 atoms high, you only have to get it correct to one-half of one percent to make sure the other machine is exactly the same size—100 atoms high!

We can do chemical synthesis: A chemist says, "Look, I want a molecule that has the atoms arranged thus and so; make me that molecule." He mixes this and that, and he shakes it, and he fiddles around. And, at the end of a difficult process, he usually does succeed in synthesizing what he wants. By the time I get my devices working, so that we can do it by physics, he will have figured out how to synthesize absolutely anything, so that my devices will really be useless.

But it would be possible (I think) for a physicist to synthesize any chemical substance that the chemist writes down. Put the atoms down where the chemist says, and so you make the substance. The problems of chemistry and biology can be greatly helped if our ability to see what we are doing, and to do things, on an atomic level, is developed.

You might ask, "Who should do this, and why should they do it?" I pointed out a few of the economic applications, but I know that the reason that you would do it might be just for fun.

Let's have a competition between laboratories. Let one laboratory make a tiny motor and send it to another lab which sends it back with a thing that fits inside the shaft of the first motor.

To get kids interested, I propose some kind of high-school competition. Even the kids can write smaller than has ever been written before. The Los Angeles high school could send to the Venice high school a pin which says on it, "How's this?"

When they get the pin back, in the dot of the "i" it says, "Not so hot."

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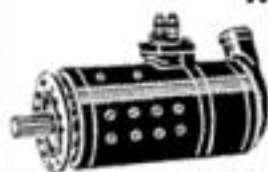
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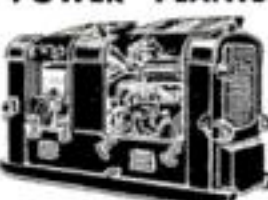


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Saturn: Our Bet in the Space Race

[Continued from page 109]

ioning thrust will ease the booster into the water some 200 miles below Cape Canaveral.

There will be three versions of Saturn—C-1, C-2, and C-3—each using the same booster design and differing only in the upper stages.

Operations schedule. The three-stage C-1 will be launched for the first time next summer. Its upper stages will be water-filled dummies, and it will travel only 200 miles downrange. The second stage will be ready in 1962. The operational rocket will start lifting heavy space probes and satellites in 1964. It will be able to shove 12.4 tons into an orbit 100 miles above the earth. Or lift 4,500 pounds into an apparently stationary, 24-hour orbit 22,700 miles high. Or gently land 2,400 pounds of instruments and radios on the moon.

The larger C-2 version will not be used until 1968 or 1969. After the C-2, there may be a five-stage C-3 Saturn. Or an entirely different rocket, based on Saturn's design, may be evolved.

Von Braun sees many important uses for all three versions. One of the most dramatic jobs for a C-2 or C-3 Saturn will be to lift a manned space laboratory and "caboose" into orbit. Says von Braun: "This would be a capsule fashioned after the present Mercury capsule, perhaps for three people. Attached to the capsule would be a sort of caboose, where the men could live and work for two weeks or so—do all sorts of research in outer space. When they want to return to earth, they could crawl back into the capsule, detach the caboose, retard their speed somewhat, and go back into the atmosphere."

Until Saturn, our previous adventures into space will have been mere darts—a grab for information at hand and a message back to earth. Saturn will make possible a true space laboratory—a stable, permanent platform sufficiently large and well-equipped to make the searching probes our expanding science demands.

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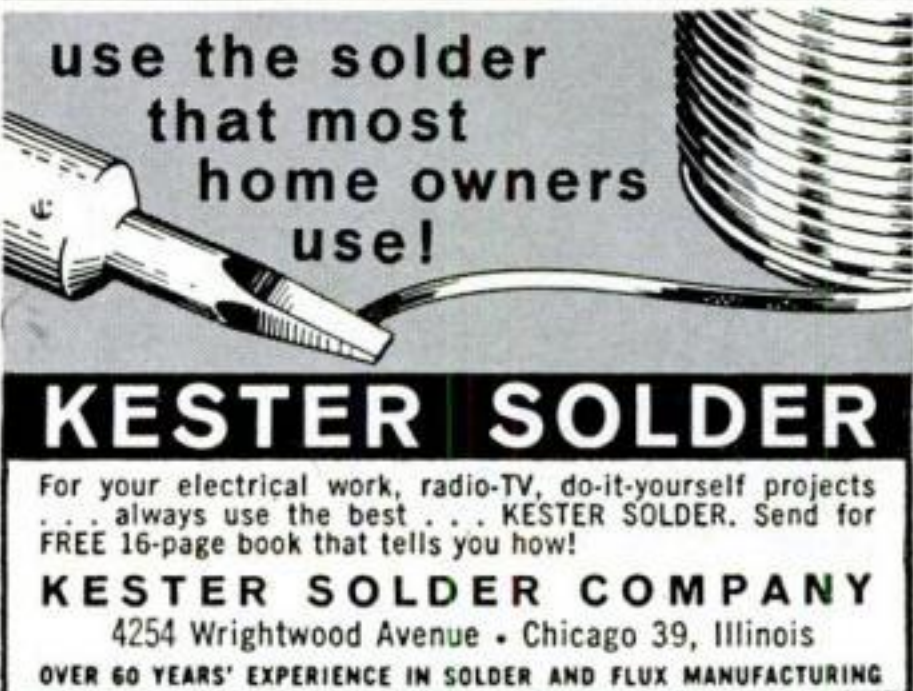
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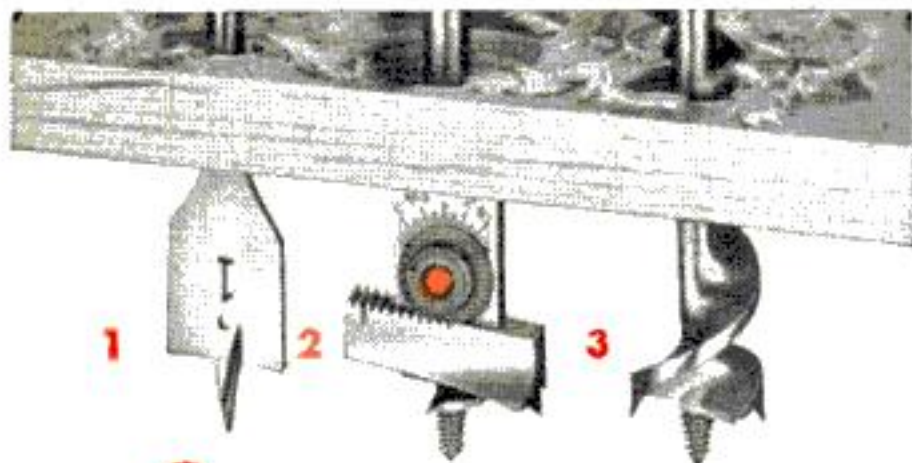
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The Rig You Need to Make Hard Cider

[Continued from page 141]

Theoretically, fresh apple cider will have enough yeast cells to start fermentation. Sometimes this may work out, but the chances are that bacterial action will get going first and cause odd flavors or a vinegar-like product. To be sure, dissolve seven to nine cakes of dry yeast, or pulverized yeast, in about 10 gallons of cider and add this to the barrel. Throw in 10 pounds of the cheapest blue raisins and rock the barrel (now about 90 percent full) back and forth to get everything mixed thoroughly. Top off the barrel, level full, and stuff a bit of clean cotton in the top bung.

Nature takes care of the rest. Just go away for about three days and give it a chance. By this time fermentation should be kicking up a few fumes and you're ready to install a U-shaped fermentation tube. A neon-sign firm gave me my U tube. From here on, air is deadly and must be kept out of the barrel. Fit the wooden plug and tube snugly into the top bung and melt paraffin around the opening for a seal. The open end of the tube goes under water so gas can escape but air can't enter. In about 10 days the whole works should be bubbling merrily in happy anticipation. Be patient. In the grand tradition, leave the tube in and watch the water level for six months. Then remove the tube and seal with a solid plug and wax.

This is the moment you've been looking forward to. If all has been done with care and respectful regard to the delicate wine-making process, the consummation will be glorious. The stubborn bung should yield a clear and heady liquid to please the most sensitive palate.

If you want a somewhat headier drink—though the law may frown on this—you can fill a wooden bucket with your wine some bitter night and place it outside to freeze. The writer sampled his stuff in a CO₂ antifreeze tester and it didn't set up until chilled to 10 above zero. So judge accordingly. Break up the frozen mass and hang it in a bag or cloth indoors with a crock underneath. As it thaws, catch the lovely drippings until about half the original mass is melted. This portion will have the most alcohol in it. Aside from its illegal aspects, this is a sport to be pursued in moderation.



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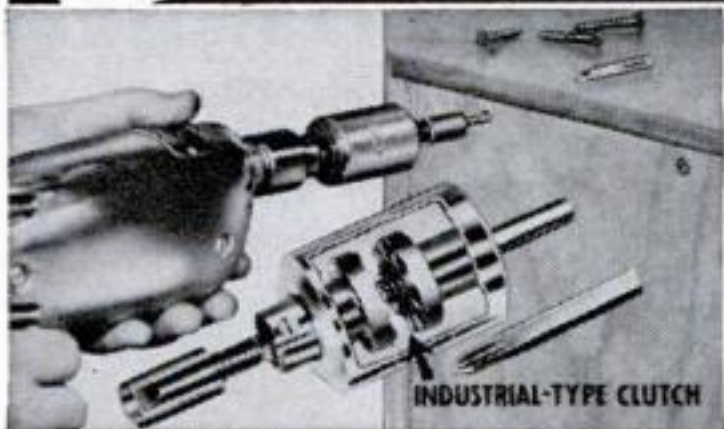
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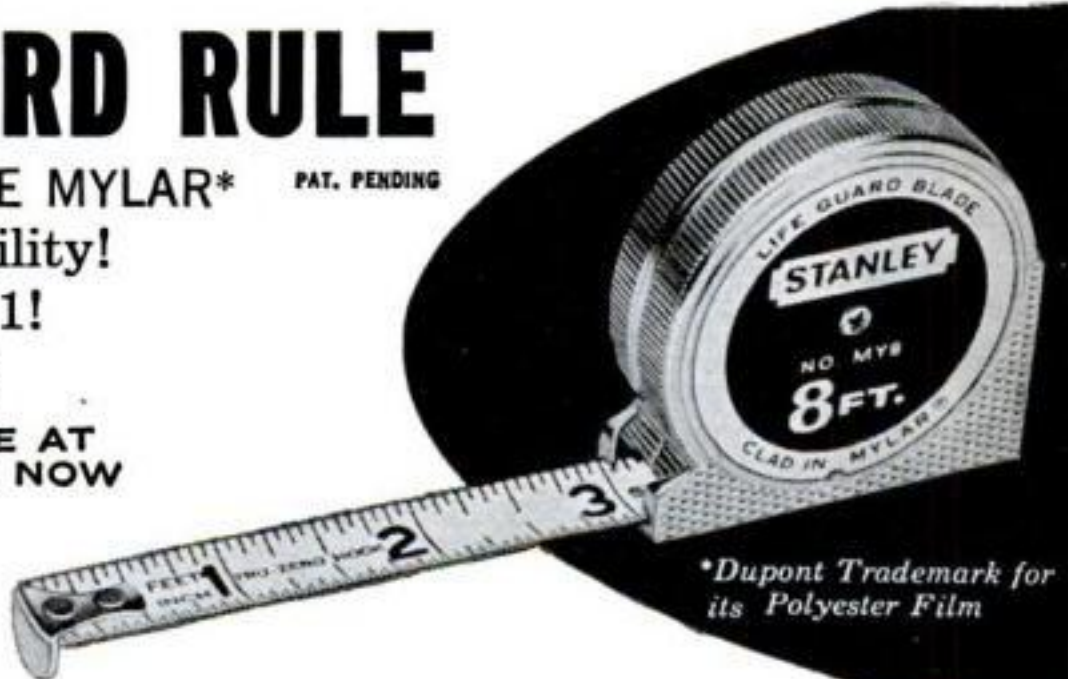
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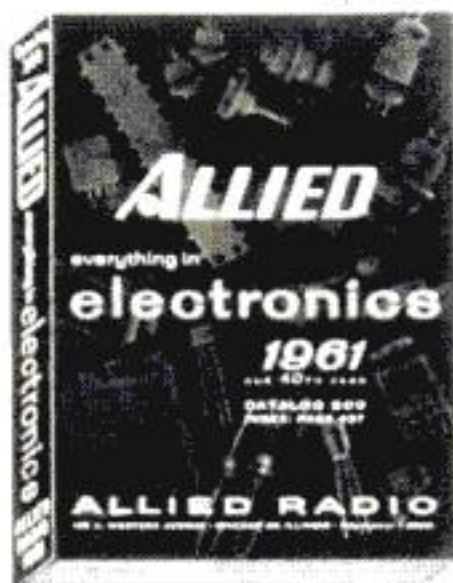
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Here Come U. S. Minibuses

[Continued from page 85]

The 80-hp. engine pushes some 3,000 lb., about 650 more than with the Corvair sedan, so acceleration is less than blinding. It's adequate to keep up with normal traffic, but passing on the highway in the 45-60-m.p.h. range requires a long, clear stretch of road. The Greenbrier cruises smoothly and easily at 60 or 65 m.p.h., and will top 70. If it's poky by comparison with conventional station wagons, the Chevy sports wagon is a ball of fire next to the VW Microbus—which strains to get up to 55.

(The Ford Econoline bus, with five more horsepower and some 340 lb. less weight, should edge the Greenbrier in acceleration. But its greater frontal area will hold maximum speed to about that of the Chevy sports wagon.)

When we moved to another truck test area, one with rugged sand and gravel roads, the Greenbrier proved its claim to the "sports wagon" designation. It clawed its way over the heaviest going with no hesitation. The weight of the rear engine on the driving wheels gave it the traction to plow through loose sand. It didn't set any speed records climbing a steep, sandy hill trail crisscrossed with eroded ruts, but it got to the top.

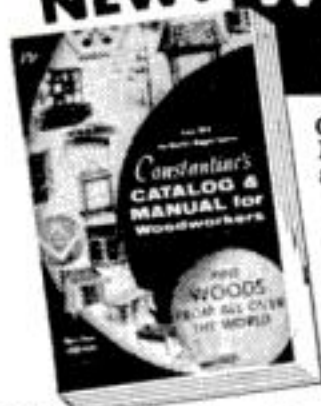
Off the beaten path, you'll do fine with a Greenbrier. It will take you into back-country camping sites and fishing holes. With two of us aboard, it negotiated ruts that would have hung up an ordinary, low-slung sedan or wagon. But with a full payload and the ground clearance down to the minimum of 6.6 inches, even the Greenbrier would have trouble making it over one of the stretches we hit.

A few squeaks and rattles developed during this rough going, but the most annoying appeared to be curable by better adjustment of the top latch of the "French doors" in the right side of the vehicle. Any lack of rigidity that might be suspected because of all that door opening pierced into the boxy body—the Greenbrier has double doors on both sides, the Microbus and Ford bus on just the right side—didn't show up during this short, but grueling, test. Long periods of rough usage might change the story.

The rear engine is audible, but not disagreeably so. In fact, it's noisier when idling than while under way.

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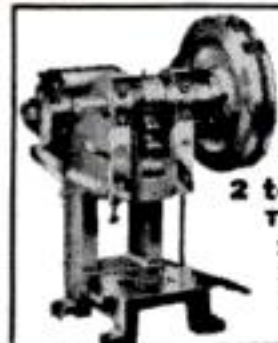


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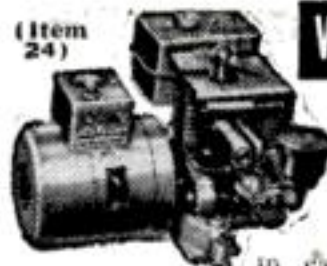


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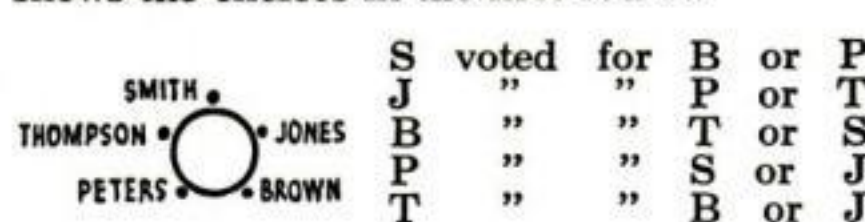
Another new unit is the Miller Electric Rodder which has patented cutters that expand automatically to the size of the pipe. It will clean out heavy obstructions in pipe diameters 3" to 12". Smaller Sizes available. But now, what are these Tools worth in COSTLY PLUMBING BILLS SAVED. Tear this Ad out—and write your name and address beside it for FREE BOOKLET on Hand and Electric Units. Obey that urge. No Agent will call. A postcard will do (Chicago Phone Kildare 5-1702)

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Answers to PS Puzzlers on 28 and 30

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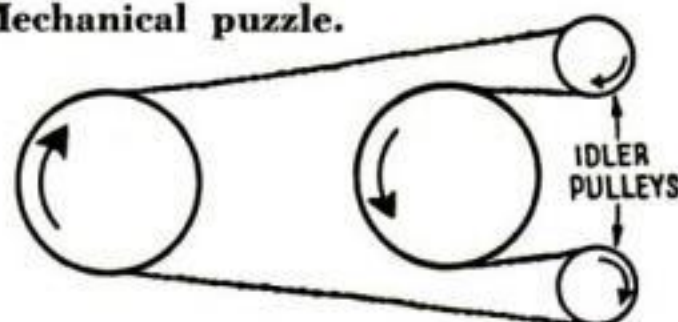
We know that Brown must have voted for Smith the first time. This forces the choice for the others, and shows immediately that Peters voted for Jones.

Sandals. 20,000 sandals are worn. Were you fooled? It doesn't make any difference what percent wore just one sandal. If half the rest go barefoot, the other half compensate by wearing two sandals each. It all averages to one sandal per native.

Sister? Yes it's possible for two unrelated men to share a sister. She's a half-sister to both. It would happen if a couple married and had a daughter, then were divorced and each remarried and had a son. The sons are unrelated.

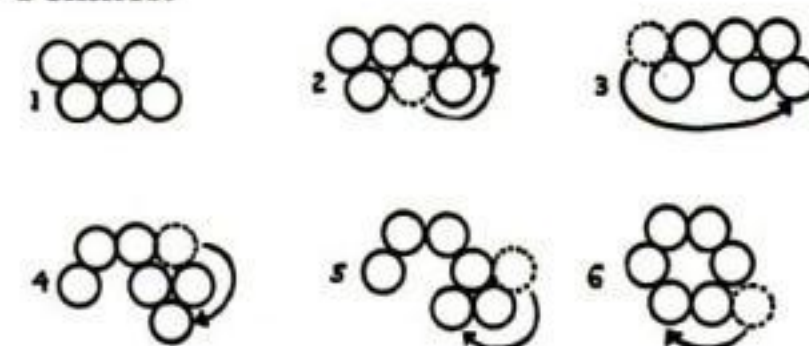
Smoking. It must have been Nov. 21. He smokes 29 cigarettes every three days by his method, 30 by hers. But given his uneven amounts, there must be a time when their totals are alike. There is: At the end of 10 days he will have smoked $29 \times 3 = 87$, + 13 = 100 cigarettes. That's 10 a day. Since the conversation took place toward the end of the month, we get Nov. 21 as the date in question.

Mechanical puzzle.



Two idler pulleys arranged this way will do the trick.

Pennies.



Used cars. Sam lost \$50. To sell the good car at \$600 for a profit of 20 percent, he must have paid \$500 for it. But the bad car must have cost \$750: The \$600 he was forced to sell it for represents 4/5 the price he paid for it. Thus he paid \$1,250 for the cars and sold them for \$1,200—a net loss of \$50.

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SAN FRANCISCO; 25c. monthly \$2.00. Whiting, P.O. Box 1145, Mountainview, California.

MAILING, Receiving, Forwarding, \$3.00 month. "A-1", 170 Fifth Ave., New York 10.

WASHINGTON Remail Service, 25c each. 6318—19th N.E., Seattle, Washington.

RUSSIA, Europe, Africa, Asia. Anywhere. Remails, 65c. Manix, Shelburne, Massachusetts.

SECRET Mail Address. Confidential Remailing-Forwarding Letters, Money, Telegrams. You Name It. I'm Ex-Trouper, with It. Details Free. Lloyd Chaplin, Box 1355, Seattle 2, Washington.

SECRET Mail Address. \$3 Month. Hedg-peth, Box 830, Alhambra 24, California.

NOTRE DAME, South Bend Remails 25c. Specify. Vlock, 486, South Bend, Indiana.

MEXICO re-airmails: Dollar bill. Replies free. Apartado 2042, Guadalajara, Mexico.

RE-AIRMAIL. Plus Stamp souvenirs, \$1. Fred Woodgate, Tamworth, N.S.W., Australia.

80B LOANS BY MAIL

BORROW \$50 to \$600 By Mail. Quick. Easy. Private. No Co-Signers. Repay in 24 small monthly payments. For the amount you want write today to Dial Finance Co., 410 Kilpatrick Bldg., Dept. M-1, Omaha 2, Nebraska.

BORROW By Mail. \$100-\$600. Anywhere. Air Mail Service. Postal Finance, 200 Keeline Building, Department 11, Omaha 2, Nebraska.

NEED Worlds of Help? Borrow up to \$600 for any purpose entirely by mail. Repay in 24 monthly payments. Write for free loan application: World Finance Co., 630 Symes Building, Dept. 110-J, Denver 2, Colorado.

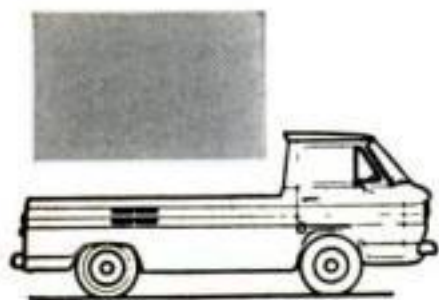
CORVAIR

95

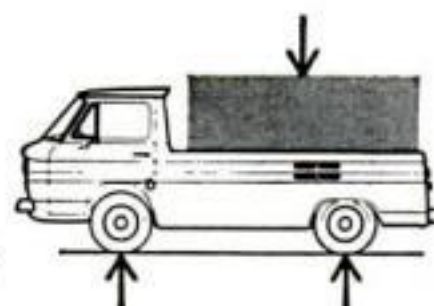
★★★★★★★★★★

TRUCKS

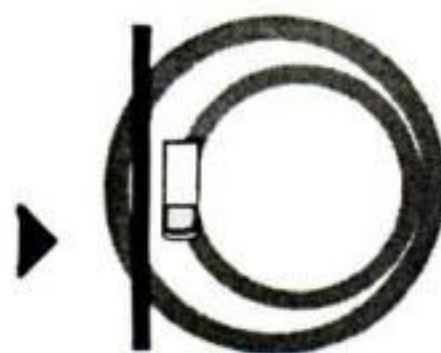
The list of Corvair 95 design advantages is as long as your arm. There's low loading height, for example; load space so accessible that the truck practically loads and unloads itself! There's exceptional driver comfort in the roomy cab. (With no hood projecting out in front, visibility has never been better.) And that snappy Corvair 95 styling is sure to spruce up any business. It's a wing-ding of a truck idea—available in pickup and van body versions. You can see 'em at your Chevrolet dealer's right now. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.



Less wear on heavy-cargo runs! Corvair 95's balanced 50-50 weight distribution reduces strain on chassis and tires. Husky 2,500-lb. capacity suspensions, front and rear, share truck and load weight equally.

[illegible]

Easiest to get around in! Corvair 95 turning radius (less than 20 feet) is less than that of ordinary trucks. That means easier maneuvering and parking, faster hauls in congested areas.







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*before you put that
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